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HIGH DEFINITION TELEVISION

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

FIRST SESSION

ON

DEVELOPING A NATIONAL TECHNOLOGY STRATEGY FOR HIGH DEFINITION TELEVISION

MAY 16 ~~MARCH 26~~, 1989

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HIGH DEFINITION TELEVISION

TUESDAY, MAY 16, 1989

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY AND SPACE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 2:10 p.m. in room S.R.253, Russell Senate Office Building, Hon. Albert Gore, Jr. [chairman of the subcommittee] presiding.

Staff members assigned to this hearing: Pat Windham, professional staff member; Fiona Branton, and Gina Keeney, minority staff counsels.

OPENING STATEMENT SENATOR GORE

Senator GORE. This hearing will come to order. I would like to welcome all of our witnesses and our guests and we will get right underway.

By every estimate HDTV stands to be the next wave in consumer electronics, but even this underestimates its more fundamental importance. HDTV is itself a potentially huge market for another product—semiconductors.

Well before the market for HDTV is fully developed, HDTV production will consume more semiconductors than the U.S. personal computer industry. Indeed, because HDTVs essentially are computers, it is likely that both product lines will begin to fuse.

If the United States, therefore, does not secure a large portion of the HDTV market, it will forego the opportunity to produce electronic components in numbers high enough to provide economies of scale. An economy of scale essentially represents the ratio of fixed front-end investment to materials and operating costs.

The fixed investment for a new semiconductor plant is very high. Sand is very cheap. Therefore, the economy of scale for producing semiconductors is particularly powerful. Without economies of scale, neither price nor qualitative competition is possible in the electronics industry.

Therefore, failure to seize this chance to re-enter the consumer electronics market means that in due course the United States will lose what is left in the semiconductor industry. Thereafter, the chances increase that we will also lose leadership in the computer industry, much of which is already highly dependent on components imported from foreign competitors.

We now have only one U.S. firm still manufacturing television sets. To speak of capturing a significant share of the market in HDTVs is therefore to speak of reconstituting an industry that has already largely left our shores—left to market forces that will not take place. Investment costs are too high, the risks are too great and the U.S. manufacturing base too thinned out. But with the government as prime mover, operating in league with American industry in a strategic capacity, it might be done.

Today's hearing is the first major effort in the Senate to focus exclusively on HDTV. It seemed logical to me that we ought to hear from government, from manufacturers and from those interested in the distribution of programming for HDTV in that order.

In fact, we have very distinguished representatives for all three perspectives, with one rather conspicuous absence. The Secretary of Commerce was invited to participated in this hearing. We thought that in view of the many statements he has made in the recent past calling attention to HDTV that he would have much to tell us and would be eager to participate in this exercise. Failing that, we thought that the Secretary would at least send a representative.

It is therefore a keen disappointment that the Department of Commerce has instead elected to remain away from this hearing, since the department will presumably be the focal point of any action the United States Government may take.

By way of partial compensation for that loss, in an effort to present what I believe to be the views of the Secretary of Commerce I have assembled a variety of press articles about the views of the Secretary of Commerce on this matter, as well as a major speech of his on the same subject and without objection I propose to have these entered into the record at that point in the hearing record where his statement would have otherwise appeared. If we cannot have the Secretary of Commerce we will settle today for a simulation of his testimony.

Meanwhile, I am pleased to say that Dr. Craig Fields of the Defense Advanced Research Projects Agency is here to present views from the point of view of national security. He will be our lead-off witness, followed by the manufacturers' panel and then by a panel of technology experts and TV distribution groups.

I will hold the record open for opening statements from my colleagues, the weekly conferences of both the Democratic senators and the Republican senators are just now concluding and we expect them to join us in a little while.

But let me just say one further word. It is apparent to this senator that the United States of America cannot allow HDTV to slip by; that while private industry is key, the Federal Government has to provide at least an initial impulse, but that it is not certain government will step up to this challenge unless encouraged by the Congress.

Personally, I believe that Secretary Mosbacher's absence from the table today is evidence that others in government do not share his views. At any rate, in order to encourage this process I have today introduced legislation designed to ensure that the U.S. Government does at

least think through in detail what would be needed if an HDTV industry is to be established in the United States.

This bill does not seek to move large amounts of money around. It does not attempt to define policy. It merely directs that by a date certain 90 days from passage, both the President and Congress shall have received a detailed breakdown of everything which must be done. We will take it from there.

Recently, the American Electronics Association released its concept of such a plan. Now, we need an equally detailed response from the Federal Government. Whether we subsequently carry out any such grand plan then becomes a matter of political choice. But first, we must have some idea of how to proceed, in what stages, with what kinds of support from the government, with what division of tasks within the government and with what levels of cooperation in industry.

I hope that the bill I have introduced today will induce the U.S. Government to take these first and most necessary steps to evaluate our situation and to formulate a strategy. Everybody who has looked at this question and has recognized the seriousness of this problem has, with very few exceptions, come to the conclusion that we must have concerted, organized, intelligent, strategic action initiated by the Federal Government. We are missing leadership. I hope that we shall soon have it.

I have an opening statement that Senator Hollings would like to have included in the record.

[The statement follows:]

OPENING STATEMENT BY THE CHAIRMAN

Last week, I chaired the Committee's first technology policy hearing of the 101st Congress, at which the American Electronics Association (AEA) released an important and far-reaching consultant's report on high-definition (HDTV). That report offers one blueprint for helping to reestablish a consumer electronics industry in the United States.

Today I am pleased that the Science Subcommittee is holding a hearing to explore both the AEA proposals and the general technology questions associated with the television issue. The hearing will examine the implications of the different choices the nation could make in HDTV technology, as well as the possible role of Federal technology programs in helping companies create an American HDTV industry. Before we help shape a national technology strategy for HDTV, it is important that the Committee hear from the major players—government agencies, television manufacturers, and the television distribution companies. The Committee's Communications Subcommittee also will continue to monitor the broad policy and regulatory issues associated with HDTV.

I expect that the Commerce Committee soon will be in a position to consider legislation to help strengthen what some have called the nation's "civilian technology base"—that storehouse of new fundamental technologies and skilled people necessary to help keep American industry competitive in today's world. The Committee will particularly consider the role and programs of the recently upgraded National Institute of Standards and Technology (NIST), the key Federal agency responsible for the civilian technology base. Today's hearing will help us prepare that important legislation.

A debate over civilian technology policy is now apparently raging within the new Bush Administration. Some officials there continue to live in a never-never land, sticking to a belief that the world operates according to so-called "free trade" and that a government role in civilian technology is either unnecessary or counterproductive. These views do not correspond to the real world, where large and successful industry-government partnerships to build new industries are now the norm. While these offi-

cials stick to the comfort of outworn ideas, the United States is literally going out of business in one industry after another. How many more industries must this nation lose, and how many more skilled manufacturing jobs must it lose, before the government wakes up?

Over the years, this Committee has worked with industry and the Department of Commerce to find new, sound ways to provide American companies with the technology base that they need to compete. We will continue this process and continue to point out that industrial success is not a haphazard process that can be left to haphazard efforts. Success results from companies that work hard and are smart and from a government that chooses to support its industries rather than abandon them.

Senator GORE. Let me ask our lead-off witness to begin. Dr. Fields, congratulations on your position and thank you for coming. Without objection your entire prepared text will be included in the record and we invite you to proceed with your presentation here in any way you see fit.

STATEMENT OF DR. CRAIG I. FIELDS, DIRECTOR, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Dr. FIELDS. Thank you very much. I am pleased to be here today in person, not a simulation, to present some remarks.

What I would like to do is to divide my remarks into three categories. First, a minute or two on what we are doing within the Defense Department, then a very short time on what the fuss is all about. I think you have covered that beautifully and there is hardly any more to be said, but then for most of my time to give you a list of nine things that I think the United States needs to have, or needs to do to have a viable presence in HDTV.

The reason I am doing that is to try to structure the subsequent discussion of who should do what, when, because that is really open to debate. I think there should be very much less debate about what needs to get done.

With respect to the Defense Department's role in the area, we have been investing in the area of advanced display technology for about 30 years that I know of. There is nothing new or special about that, and propelled by interest in high definition television a number of new technical ideas have appeared which can either increase the performance of displays, lower the cost of small volume production due to innovations in design or, if the right companies are successful in high definition TV, further lower the cost due to mass production and innovation in design.

So we are excited about it and decided to invest for what I will consider our traditional reasons. We put out a competitive procurement. We received just short of 90 proposals and we have narrowed those down to just short of 50 proposals.

I want to characterize the proposals in a few words. Number one, absolutely excellent technology—the best I have seen anywhere and better than I think exists anywhere else.

Number two, cost-sharing from the industry—more investment from them than would come from the Federal Government.

Number three, by and large not proposals from individual organizations but from joint ventures, teams, consortia and so on.

Next, an emphasis not only on systems—whole display systems—but also on the underlying components that can also go into personal computers, work stations, publishing systems, many other products.

Next, an emphasis not only on the products themselves, be they components or systems, but also the manufacturing technology for subsequent quality production.

Next, both big and small companies being involved, balancing the advantages of the large against sometimes the high levels of innovation in the small.

Lastly, both commercial firms and defense firms each adding their special flavor. In particular, there is a good deal of technology and image compression and image analysis in the defense technology base and I am pleased to see that merge out into the commercial and civilian sector.

We have struck up a very good relationship with the Department of Commerce in which we acknowledge their leadership in the Administration in putting together an overall plan. They have worked with us on the selection of proposals. If they choose, they are invited to work with us on the subsequent management of the technology effort.

In running the effort, we have chosen certain business practices that I think are just common sense. We are not imposing any unnecessary military specifications that would raise costs. We are not going to control intellectual property rights in a way that would discourage private investment.

We are not going to put on additional export controls that would keep U.S. companies from competing in a world-wide market, additional to those that might come from the State Department or Commerce, that is up to them.

I view that DARPA's added value in this effort is not only selection and funding proposals but also in building teams, getting the work stations set up so that they are deliverables and they work together as one group and also trying to combine them with our on-going technology development involving well over 300 other companies, working in areas like VLSI design, semiconductor production and many other things that can benefit these companies that will enter our program.

We expect to make our first announcements later this month, but I will underline the word first announcements. They will come in a sequence after that. So that is what we are doing.

Let me go on to the next section, namely, what is the fuss? Well, you said it very clearly. The "New York Times" editorial of yesterday said it clearly. Namely, this is a semiconductor issue, subsequently a computer issue. It is not something as frivolous as simply, better quality TV pictures.

From a defense point of view we want to minimize our dependency on foreign sources for the essential elements of our weapons systems. Those essential elements certainly are centered on semiconductors. That is one of the reasons we are pleased to fund Sematech—and inciden-

tally, that program is going very well. They are on schedule, in budget. delivering results.

Let me go on to what I think is the most important part of my remarks today. Namely, what I think the United States needs to have or to do to have a viable presence in HDTV, leaving aside who will do it. That is the debate. I have divided these nine items into three categories—high priority items that are just essential, a medium priority item and a couple of lower priority items. Within each category, they are not in any order.

Under high priority items, we have to have technology—intellectual property. We have to know how to make displays and display processors, how to make high density recording equipment and cameras and how to do the transmission. Right now the DARPA program is addressing part of the display and display processor activity and there are no comparable investments that I know of in high density recording camera technology and transmission.

Underlying our efforts in the nation in technology, be they funded by the government or privately, we need a sensible policy to be followed by the Committee on foreign investment in the United States, the CIFIUS chaired by Treasury, so we do not find companies being bought out from under us and that is something I deal with every day.

Item two is manufacturing capacity. Unless we have enough factories with enough capacity to produce enough TVs and VCRs to get market share, we will not be able to sell enough product and thus sell enough semiconductors to get that economy of scale you spoke of. We need manufacturing capacity in semiconductors and displays and VCRs, in HDTVs and incidentally, if we get into satellite transmission, in DBS antennas.

Again, we need a CIFIUS policy. There may or may not need to be a relaxation in antitrust. This is easily the most expensive part of the whole enterprise, because of the large capital investment needed for setting up new factories. We are talking about billions of dollars that have to be raised somehow.

Number three is that we need an adequate quantity of video software. We have to have TV to watch. I would be personally astounded if the government took part in that part of the enterprise, but the simple fact is that unless there is TV to watch, no one will buy TVs and hence, no one will buy semiconductors. It has got to get done.

Next issue is, we have to have an adequate richness of distribution channels for HDTV. We are certainly going to have terrestrial transmission. We will probably have cable transmission, but will we have DBS? Will we have fiber? Are there impediments or barriers to DBS and fiber that perhaps the government should remove? That is part of the debate.

Next issue is, there needs to be an environment for competitive pricing. This involves enforcing our antidumping laws, calculating penalties properly and promptly and having an appropriate fair trade policy. I am the last person to want to promote any protectionist moves, but we do have to interact with real competitors in the world and we might

have to do the right thing and that has to get prepared in a thoughtful manner.

Next issue and the last issue under what I will call the high priority items is, the public has to get educated. If they do not want these, they are not going to buy them, hence we are not going to sell semiconductors and there is a tremendous marketing activity being driven by both private and public funds abroad in both Europe and Japan. There is no such thing in the United States at the moment. Again, I am not prejudging who should do it here. Again, I would expect it to be essentially a private activity.

Let me go to the one medium priority item and you may be surprised at its medium priority, but I think you will see why. Namely, the issue of proper selection of standards.

The fact is, we need to choose standards that are good. We need to choose standards that are what I will term friendly among terrestrial broadcast, cable, DBS, fiber and videotape and that could be done technically. We have to choose standards for production and transmission that are reasonably well-matched.

We have to make efficient use of the broadcast spectrum. We have to choose standards that are flexible to accommodate rapid technology change. Whatever standards we choose, they are not going to last another 30 years like the last standards. We have to know that in advance.

We have to be mindful of 160 million NTSC televisions in place—50 percent of U.S. households; 43 million households with cable and 1,500 broadcast stations. All of that has to get done, and done properly, but none of that discriminates between U.S. production or foreign production.

There are two standards issues that do discriminate. One is timing. If we choose a standard too early, before American companies are ready, it is not good. If we choose it too late, de facto standards may get set in a thoughtless manner—also not good. Timing has to be correct.

The other factor that discriminates vis-a-vis standards is intellectual property. If it is the case, as attorneys have told me, that one in fact can get intellectual property protection for the decoding apparatus for standards, then it will be a case of where do royalties flow? Do they flow into the United States in several hundred million dollars a year, or out of the United States in several hundred million dollars a year? These are the issues—the timing and the intellectual property issues—that cause the choice of standards to help U.S. industry or be neutral.

The last category, under what I will call the lower priority items, may seem strange as lower priority. One of them is human resources. In fact, no one is more concerned than I with the state of education in the country, but now and for the next five years or so we just do have good engineers, we have good scientists and that is not my immediate concern here, although I think we should lay the groundwork in universities for the next generation of technology beyond this.

The second low priority item and the ninth on my total list is sales channels. The fact is, we have rich sales channels in the United States. There are rich sales channels in Europe and Japan and we will see in the future whether those sales channels abroad are open to U.S. manufacturers.

Now, with that as a list of the topics that need to be addressed, with the debate in each topic of what does industry do, what does the Congress do, what does the Administration do, I would like to tell you what I think is one impediment to proceeding.

Surprisingly, I do not think the top of the list as an impediment is the Administration getting its act together to produce a plan. That is on-going and I am hopeful that a good document will result. I also do not think at the top of the list is the Congress getting its act together, because there is a lot of interest on the Hill. There is more coordination on a bipartisan basis than I have seen on some other issues—many other issues—and I am pleased with that.

What I am concerned about is the industry. Not the industry enthusiasm and the industry intelligence—you will see all of that from Pat Hubbard later. But the question is, who can speak for the industry? If the Administration says, look, we will do this, the Congress says, we will do this, who can speak for the industry and say, we will do this?

Because unless all three agree upon a concrete set of standards we cannot go forward. The Administration cannot do it alone, the Congress cannot do it alone and the industry cannot do it alone. So that is something that the industry is going to have to face and we will work with them to that end.

Thank you very much.

[The statement follows:]

STATEMENT OF DR. CRAIG I. FIELDS, DIRECTOR, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Messrs. Chairman and Members --

I appreciate the opportunity to appear before you to discuss DARPA's activities related to America's participation in High Definition Television.

The Defense Department has for many years acquired high definition displays for such applications as training simulators, command and control systems, and intelligence work stations. Because of DoD needs for high performance in its displays, until now well beyond commercial or consumer demand, we have had a focused R&D program to develop new technology for displays, display processors and man-machine interaction. In a nutshell, we have been supporting work in these areas for years, but I thought we were in the computer business, not the high definition television business.

During the last few months I received some exciting unsolicited proposals for displays and related components. The display technology embodied in these proposals could have tremendous significance for Defense. These proposals were based on innovative ideas and designs that could lead to much lower cost displays for Defense, even in the relatively small production volumes that the Military Services need. If the technology were mass produced, propelled by the success of HDTV, considerably greater economies would be realized by Defense. In some cases the proposals also promised greater display performance than now available from any available technology, regardless of cost or country of origin, making plausible Defense applications that have heretofore been just dreams, e.g. very large scale dynamic high resolution map displays. Finally, some of the proposed technology had application far beyond displays, e.g. to high speed digital signal processing.

I decided it would be desirable to make some hard choices, review our priorities, and reorient some of our ongoing work in man-machine interaction to accommodate these exciting new ideas, and in the interest of fairness to issue a competitive Broad Agency Announcement (BAA) to solicit proposals from those organizations that might have excellent technologies and capabilities, but not know of DARPA's interest in this area. More to the point, this is the best way I know to find out what industry can do, what industry wants to do, and what industry wants the Government to do. Incidently, we issued our procurement only after we

spent months conferring with US industry to get their views.

When I learned more about the international HDTV situation I came to believe that our program was not just desirable but essential. HDTVs will consume large quantities of semiconductors, as you can see from Attachment 1. The country whose companies supply those semiconductors for HDTV will enjoy a significant economy of scale of production, and will have the massive revenues needed for refining manufacturing and the ever increasing expense of R&D required for developing next generation semiconductor products. In turn, that will give those companies competitive advantage in supplying semiconductors for products other than HDTV, e.g. automobiles and telecommunications, and in fact will give them leverage in gaining market share in those other "down stream" industries.

I received a very interesting report from the Electronics Industry Association of Japan, a Statement on Semiconductors dated 21 November 1988. On page 3 they say "Japanese investment plans [for DRAM production facilities] in the near future have sharply increased. This does not reflect predatory intent but rather a conviction that demand - especially for memory chips - will grow and stabilize with the introduction of new end use products using much larger quantities of DRAMS (such as . . . high definition TV)." This explanation for their investment did not reduce my anxiety.

Further, to the extent that HDTVs evolve to be computers, as digital technology inexorably replaces analog technology, an evolution that is inevitable even if its speed is debated, the companies that produce HDTV will have a competitive edge in capturing market share in the computer industry. Again the issues are economy of scale and refinement in manufacturing, as well as R&D for product improvement. This is illustrated in Attachment 2.

Referring to that same Japanese report, on page 3 and page 22 they list some of the other end use products that share a common technology base with HDTV, namely laser printers, digital copiers, intelligent work stations, laser fax machines and personal computers. HDTV cannot be separated from office equipment and publishing, to name just two examples.

Before getting into the larger issues I would like to say a few things

about the business practices we are following with our high definition display program:

1. None of the work will be classified, although we expect the results to be used in a number of classified programs in DoD.

2. While the result of our work will be subject to the usual U.S. export control regulations, DARPA will seek no additional controls that might cripple US firms in their efforts to export. In particular, if equivalent technology is readily available from non-US sources, then we may be working at odds with our own goals of bolstering the competitiveness of US industry if we seek to limit exports. In any case our concerns are not with the export of televisions but with the export of manufacturing technology. I hope we can rely on the good sense and proprietary interests of our companies on that score.

3. In order to keep open the opportunity for large scale production, the fundamental technology developed will not be specialized for unique military needs. This would inevitably significantly drive up costs for the military and everybody else. Thus the issue here is not a matter of spin-off -- crumbs from the table -- but rather that we are dealing with the same component technology in the military and civilian sectors.

4. We will assign data rights and patent rights to the companies involved whenever possible and protect their intellectual property rights, so as to motivate them to invest private capital following the initial higher risk Government funding.

In following these four guidelines we are doing exactly the same as we have with our fifth generation Strategic Computer program in parallel high performance supercomputers, software, and artificial intelligence; in neural nets and high temperature superconductors; and with SEMATECH, intended to develop world class semiconductor manufacturing technology. With respect to SEMATECH, I was pleased to see the recent report "SEMATECH 1989: PROGRESS AND PROSPECTS" being prepared by the Department of Commerce, which supports that we are following the business practices outlined above.

5. We have invited interested parties from Department of Commerce, which includes NIST, the FCC, NSF, the Department of Treasury (Customs), NASA, and other parts of DoD and the Government to work with us on the selection of proposals and subsequent oversight of the effort. My intention is to form an ad hoc Executive Branch Joint Special Projects Office to address this High Definition Display work.

Incidently, DARPA is not deeply involved in the issue of standards, although we have established ongoing coordination with the FCC so as to synchronize schedules and we have invited them to participate in our proposal selection and subsequent program management as described. We have informally reviewed about a dozen transmission standards that have been proposed, and we are planning to use our unique supercomputer capabilities to support a simulation laboratory for exploring transmission standards. We are currently thinking about ways that those transmission standards can be improved and that the US might get a competitive edge by leveraging off of our technology strengths in areas of image compression algorithms, encryption and software, mostly developed through past Defense investment.

6. What about participation of foreign firms or subsidiaries of foreign firms located in the United States? It may not be possible to have an All-American solution given that certain capabilities like producing certain discrete electronic components may only be available offshore or in US subsidiaries of foreign firms, at least during the near term.

As for foreign subsidiaries of US firms, we will not insist that they be excluded from use of the technology developed by their parent company, although we will discuss the conditions under which that transition will take place.

My job is to work with the bidders, some of which will have foreign connections, to get the best deal I possibly can for the US, and that is what I intend to do.

7. Cost sharing by industry is a competitive criterion in our program. This is not a Government bail-out; we are serving an essential catalytic role. DARPA's investment will reduce risk for the bidders, and effectively provide them with some lower cost capital.

8. We have tried to work very closely with industry associations, like the AEA.

9. We have asked the Defense Manufacturing Board, a distinguished panel of industry experts, to form a working group to advise us on our program.

I'll return to a discussion of DARPA's current program shortly, but first what is DARPA's larger role in all of this? First, for thirty years my Agency has invested to assure that the highest performance technology is in the US Defense industrial base, in areas such as high performance computers, software, artificial intelligence, computer communications like the ARPANET, advanced materials, semiconductor design, lasers and so on.

Second and more recently, we are investing in manufacturing technology in areas where Defense is essentially the only customer, but such a small and unpredictable customer that private industry has been reluctant to invest to develop the production technology needed to raise quality and reduce costs. Examples include high performance infrared focal plane arrays needed for many weapons systems applications and millimeter wave and microwave monolithic integrated circuits (MIMIC) required for such applications as high performance radars.

Third and most germane for HDTV, over the last few years the Defense Department, with DARPA as its primary instrument, has taken the position that National security requires an assured domestic supply of the highest performance and highest quality technology in our industrial base. There are several reasons. One is mobilization. Some reasonable wartime scenarios include a period of increasing tension, and during that period we need a surge capability. Stockpiling of high technology items is impractical because of the rapidity of change in high technology and the variety of items required, and it is impossible to assure alternative sources of foreign supply for any but the most common items. A second and more compelling reason is that the Defense industrial base cannot be separate from

the much larger volume commercial and consumer industrial base, a point brought home by the 1987 Defense Science Board Report on Semiconductor Dependency. The economics just don't allow DoD to go its own way, and as the civilian industrial base moves off shore the risk for Defense sharply increases. In other words, it's hard to separate national security and economic strength. Third and most troublesome, if our military adversaries turn to the companies in foreign countries for their weapons systems technology, perhaps through theft or surreptitious purchase, and if that technology is more advanced or available earlier than in the US, we will be in serious trouble.

DoD can't afford to assure a domestic supply of all technology, and I generally use three criteria in devising an investment strategy. First, we need to concentrate on technologies of the greatest military importance. Secondly, we need to concentrate on technologies that are rapidly improving, so that we suffer a real disadvantage if we get behind even by a few years. And third we must focus on technologies that have leverage for a wide variety of end use products, so as to get the greatest benefit from our investment. Semiconductors, computers, advanced materials and machine tools are clear examples.

DARPA has concentrated heavily in the area of semiconductors, not only with our investment in SEMATECH but also through a much broader program of semiconductor production technology, such as excimer laser, e-beam and x-ray lithography. We have always had a major investment in computer and software technology, and are the only Government Agency supporting the major consortium in that domain, the Microelectronics and Computer Technology Corporation (MCC). Our investment in advanced materials is smaller, but notable for its concentration on the manufacturing of high temperature superconductors and support for several consortia forming in that area.

Thus DARPA's investment in high definition displays is a natural outgrowth of past investments and our strategic plan. We have to establish the very best high definition display technology, including manufacturing technology, in the US industrial base. Now I would like to turn to the question of what we will do next.

Where are we and what did US business say they could do, wanted to do, and wanted the Government to do? We have received 82 proposals and 5

white papers. The proposals address not only product technology but manufacturing technology, including special manufacturing equipment, embodied in pilot production lines as well. The proposals address components, like semiconductors and displays, as well high definition display systems. The components and manufacturing technology are also applicable to intelligent work stations and personal computers, and to an extent other office equipment and publishing equipment. I am struck by three things: 1) The contents of the proposals - product technology and manufacturing technology - is outstanding; 2) US companies, in some cases joined by universities, have formed themselves into strategic teams and formed alliances that did not exist before; and 3) there is tremendous cost sharing by industry. Government funds serve as a catalyst and serve to reduce risk, not to bail out industry.

Many of the companies traditionally do not do business with DoD -- we have tried to mobilize a new talent pool. Where defense companies have proposed to play a role they have offered to make use of technology, like signal processing and image compression, from the current defense industrial base. Many of the companies are the innovative small businesses that are America's strength -- but in this case linked to large companies with tho know-how to capitalize on invention. There is a strong representation of companies from the computer industry. Two of the proposals were from the Microelectronics and Computer Technology Corporation, or MCC, one of the Nation's leading consortia.

DoD has issued a press release listing the companies and other organizations involved.

We are now reviewing the proposals and opportunities. We will form these teams into a cohesive program, and that will be done very soon. This is routine business practice for DARPA. For example, in the supercomputer part of our Strategic Computing initiative we arranged for a number of computer companies to cooperate in the use of shared chip making facilities that they could not have afforded on their own; to compete in the areas of computer architecture and pricing; and to cooperate in the area of software so that the Mach operating system, our successor to Unix, is now the common standard for nine different types of supercomputers. In the HDTV area I was pleased to see that AT&T and Zenith had joined forces, and we intend to create more such links.

Important value will be added to the enterprise by our integration of the high definition display efforts into the ongoing DARPA technology combine. We will make available to the new contractors the very best VLSI design tools in the world; unique facilities for rapid prototyping of analog and digital, silicon and compound semiconductor circuits; the highest speed supercomputers for simulation and design; the most advanced algorithms and techniques for image compression and signal processing; CAD tools for dealing with the mechanical aspects of systems, and rapid prototyping capabilities for mechanical parts; to the extent software is involved, the Software Engineering Institute will help in seeing that the most advanced techniques are used for implementation; as optoelectronics are employed, the latest components will be available from our current contractor base; the latest microelectronics packaging technology will be available to the new players; computer-based and in some cases artificial intelligence tools will be available for the manufacturing pilot lines for such tasks as planning and scheduling, as well as for concurrent engineering; the latest microelectronics fabrication techniques will be available through a close link to Sematech; and special circuits and boards for signal processing will be introduced.

Further, we keep in close, if informal, contact with the venture capital community. With the permission of both parties, we will try to make connections between those investment sources and companies that have submitted proposals to DARPA.

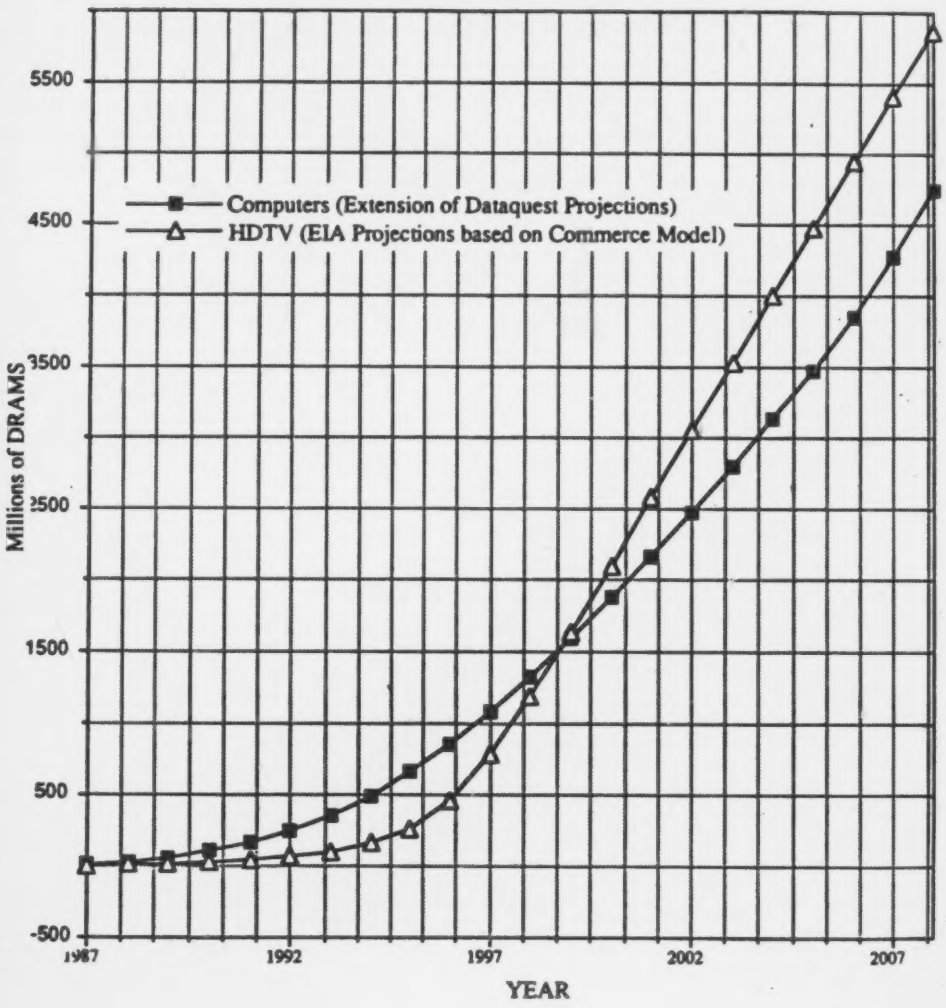
Finally, we will identify gaps in our program, and solicit additional proposals to plug those holes.

DARPA is essentially unique in the Federal Government in having a staff of technology managers with the experience and track record in National initiatives to make available new technology products in the US defense industrial base; in forming industrial teams and supporting consortia for DoD; and in supporting a vertical and horizontal defense industrial technology base unmatched by any individual US company. The latter allows us to leverage complementary leading edge technologies ahead of anyone else, gaining precious lead time.

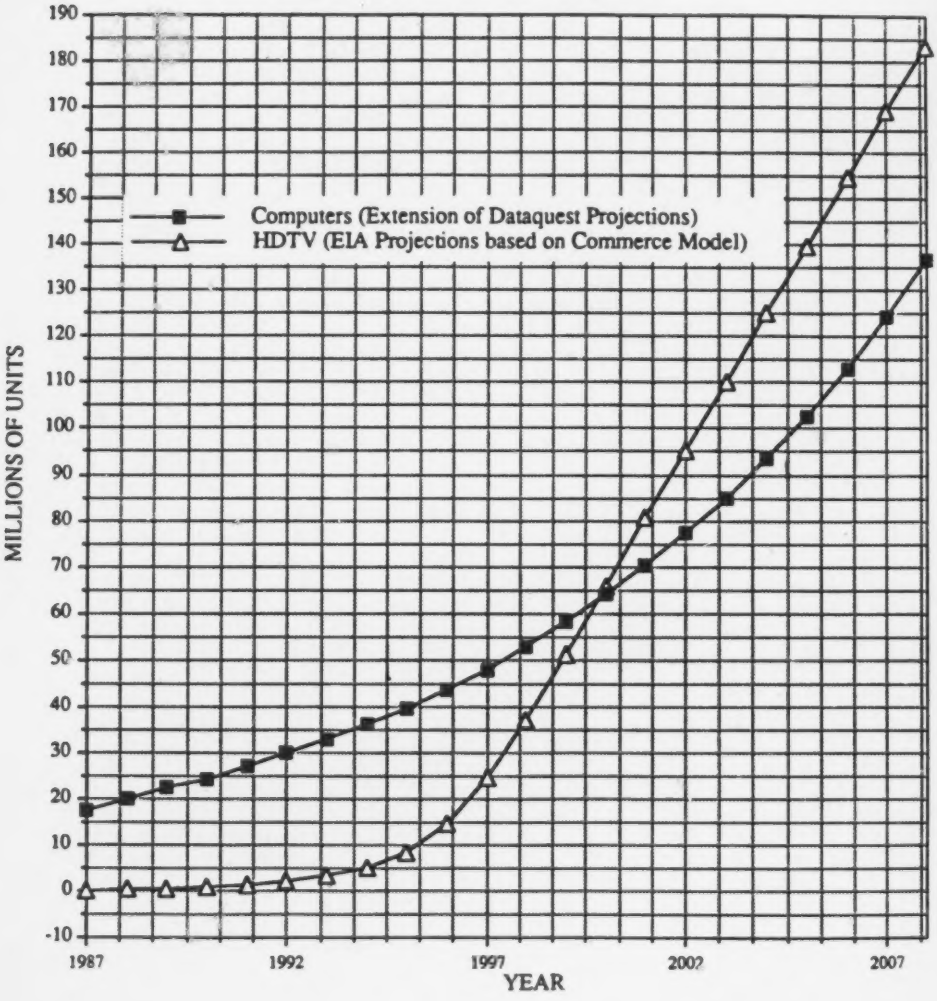
DARPA took a first small step by starting our high definition display initiative; and, industry has responded with the next natural step of planning and forming teams that can respond to our need. If, as we believe,

HDTV is the driver of advanced electronic technology, the US can be back in the driver's seat again if we just show some initiative and spunk -- now. Thank you.

Comparison of World-Wide DRAM Usage in Computers and HDTV



Comparison of World-Wide HDTV and Computer Sales



Senator GORE. Well, thank you very much, Dr. Fields. Let me start off the questions, but before I do that I want to recognize our ranking Republican, Senator Pressler.

OPENING STATEMENT BY SENTOR PRESSLER

Senator PRESSLER. Mr. Chairman, I have a brief statement for the record.

Mr. Chairman, thank you for calling this hearing on the role of the Federal Government in commercializing high definition television, or HDTV. We heard last week at a full-committee hearing how important this technology is to America's electronics and computer industries. We have already lost the bulk of our consumer electronics industry. What are we going to do to keep advanced television?

Technologically, we have not lost HDTV. This country has the best innovators and inventors in the world. We still lead in computer technologies, and we have the chip manufacturing capabilities to build HDTV's. The problem is that economic and regulatory conditions in this country are preventing industry from developing commercial applications for their inventions. We need to examine the antitrust laws, the Tax Code that rewards short-term rather than long-term investments, and poor enforcement of antidumping laws, to see whether they are preventing commercialization of important new technologies and hampering our efforts to compete.

Last week, the American Electronics Association released a business plan for developing HDTV. That plan involves commitment of over $1 billion in Federal funds, including Federal loan guarantees and Federal loans. I think that before we commit any taxpayer money to advanced television, we need to consider just how much the Federal Government should do to assist the private sector in regaining its competitiveness. The Federal Government already spends over $60 billion each year on research and development. There may be other ways to encourage American industry to develop new technologies like HDTV without spending more money.

As we consider the Electronics Association's proposal, we should also keep in mind its effect on the Small Businesses that are already developing HDTV systems. American small businesses are responsible for many of the new technogical developments of the past decade. They are the country's primary source of innovation. Small companies have created the largest growth in new jobs for American workers. We have to make sure that any Federal HDTV legislation preserves and encourage America's greatest strength—its small businesses.

Advanced television involves many complicated issues. I am glad we are having this hearing so we can make rational and informed decisions when the time comes. I look forward to the comments and suggestions of our distinguished witnesses this afternoon.

Senator GORE. Senator Bryan?

Senator BRYAN. No, Mr. Chairman, I will reserve my time for questions as well.

Senator GORE. Very good. Let me go over some of the fundamentals very quickly. First of all, high definition television is so important, not because it is a real improvement in picture quality and a significant new product for the consumer electronics market. This is not to say that it is unimportant as a new consumer electronics market, or that it is not nice to have a better TV picture, but those are not the reasons for all the attention paid to HDTV. Correct?

Dr. FIELDS. That is absolutely right.

Senator GORE. The fact is, in order to present the kind of picture and sound which this entertainment device will be capable of presenting, it will have to process large quantities of information.

Dr. FIELDS. Correct.

Senator GORE. We have long since passed the point where information in such volumes is processed in any other way than digital.

Dr. FIELDS. Digital technology is the preferred means. No one builds analog computers any more.

Senator GORE. All right. The kind of semiconductors and the number of semiconductors which will be necessary as part of an HDTV set and industry represents a quantum leap in the kind of semiconductors broadly available in the consumer electronics marketplace. Correct?

Dr. FIELDS. That is correct. Let me just sort of put it this way. If HDTVs were not rich in semiconductors, this would not be a national security issue in any way. If the semiconductors in HDTV were in some way technologically unique and unrelated to the larger semiconductor market elsewhere, this would not be of interest. If there was not such a huge economy of scale in producing semiconductors this would not be of interest.

But in fact, it is rich, they are not unique and underlying technology and there is tremendous economy of scale. It is that combination that causes people to believe that the loss of a consumer electronics industry could be undermining the whole electronics industry.

Senator GORE. If you look at this new generation of semiconductors of the kind that will be used in HDTVs, what percentage of the world marketplace for those kinds of semiconductors will be represented within 10, 12 years by the ones included in HDTVs?

Dr. FIELDS. I am not sure of the exact figures, because of course it depends on projections and as Jerry Pearlman may say when he gets to the table, there may be no chip in common between HDTVs and other products but there will be common underlying production technology.

Leaving that aside, it is a very large percentage. There is a 20 percent, 25 percent, 40 percent—it is a very large percentage of DRAMs and those are sort of the fundamental rights of the semiconductor industry.

Senator GORE. I have seen projections as high as 40 to 50 percent.

Dr. FIELDS. It could very well be true. There are a number of projections. They are converging as people learn more. It is an argument about how bad is the news? Very bad, or very, very bad? It is not good news.

Senator GORE. Now, television started going digital a few years ago, did it not?

Dr. FIELDS. Yes, that is quite true.

Senator GORE. I have seen some projections that indicate that television sets are already approaching computers in the volume of D RAMS contained in those products. If you have additional information for the record on that, we would like to hear from you on that point.

Now, jlet me close out this series of questions. You have both a new level of sophistication in semiconductors and potentially a significant percentage of the total volume of these semiconductors contained in one product—HDTV. If one group of companies controls HDTV, they will have the ability to write the specifications for the semiconductors contained in them.

Dr. FIELDS. I think that is right. The way I think about it is whatever companies are producing the semiconductors for HDTV will have such a large production volume, hence economy of scale. Such revenues for research and development and plant modernization that they will be in a terrifically competitive position for supplying semiconductors to everything else that is not HDTV, computers, telecommunications, automobiles, what have you, and that is really the competitive advantage that I think you are concerned about here.

Senator GORE. And then if they dominate that family of semiconductors, then they would have a tremendous advantage with the remainder of the so called "electronic food chain." This would give them entree into all other product lines where these semiconductors are important. Am I correct?

Dr. FIELDS. That is exactly right. Most people do not appreciate that so-called U.S. computers—everyone thinks we have a strong U.S. computer industry. Our assemblies of Japanese components to a large extent, that is just the way it is now. Cray buys their chips from Fujitsu, a company like Digital Equipment buys many of their chips, and so on and so forth. That dependency cannot make them comfortable.

Senator GORE. Now, what do you believe is the most significant thing that government could do? Should we amend the antitrust laws or is that one of the items that we should place farther down on our list of priorities?

Dr. FIELDS. Well, I am actually going to resist today if it is possible, Mr. Gore, discussing the particular items that may be done except as a list because I do not want to sort of steal the thunder of the Department of Commerce when they come with the administration's plan later. That is one of the items. There are many, many possible options. The issue is to get this partnership among industry, Congress, and the administration.

Senator GORE. Distant thunder. I hope that an understandable elemental policy does quickly emerge. But let's step back and ask—who is us? Who is a U.S. firm? Can a foreign-owned firm be the functional equivalent of a U.S. firm?

Dr. FIELDS. Well, we have grappled with that, as you might expect, to a great extent in our procurement, and we do not only in this book here but all the other Defense Department and DARPA business that I am engaged in. Let me refer to a list of some of the factors that we take into account, and you will see how difficult this is.

I care a lot about where the research and development is done. I care about where the assembly is done, and I am going to use assembly instead of production to make clear that I am dealing with assembly. I care about the citizenship of the scientists and engineers and managers and workers doing R&D or doing assembly.

I mention that because in some cases foreign owned firms in the United States use U.S. citizens in all jobs and other cases foreign owned firms in the United States use U.S. citizens for the lower level jobs but their own citizens for the higher level jobs.

I care about stock ownership, both voting stock and nonvoting stock separating the ownership from control issue. I care about leasing policy for intellectual property. Where is it leased, to whom, under what basis.

I care about where they buy their components. Are they buying U.S. semiconductors or something else? I care about where dividends are flowing, where profits are flowing.

When you add this all up, it gets to be a very complicated picture as to what is exactly a U.S. company and what is not a U.S. company. There are foreign owned companies that have R&D in the United States, assembly, production in the United States, build semiconductors here and are very American along all of those lines. Other companies that have American sounding names, and they are great companies that have R&D abroad, production abroad, and so on.

I do not know any simple rule. I wish I had one. We have to deal with each case on its own merits and its own basis.

Senator GORE. One final question because my red light has come on. I just want to say that in my opinion the antitrust measure that has been discussed is farther down on the list of priorities. It is on the list , yes, but it is far from the most essential step. Tell me what is your reaction to the proposal from the Federal Republic of Germany that the U.S. and the Federal Republic join an HDTV effort to compete with Japan?

Dr. FIELDS. I have not seen the details of the proposal. My staff is also discussing such proposals with Italy and with France, incidentally, and in fact, we have been approached by Japan, too. The proposal which consists of sharing of intellectual property and knowhow may not be a good deal for the United States if foreign companies are better able to capitalize on that knowhow and better able to control markets. It all depends on the details, and I have not seen them yet.

Senator GORE. All right, thank you. I apologize to my colleagues for going a bit over my time.

Our ranking Republican member, Senator Pressler.

Senator PRESSLER. Thank you very much.

Going back to a very basic question just for the record, and if you were explaining this to the Kiwanis Club in my home town of Humbolt, South Dakota, why does the government have to be involved at all for the development of high definition TV? Why does it not just happen if it is a desirable thing?

Dr. FIELDS. Well, that is a two-part answer. First of all, you have hit on a very fundamental problem, namely, showing the American public, educating the American public as to why this is important, because it is a very obscure thing in many ways as far as technical insights that most people are never exposed to. So, that is going to be a challenge for all of us. But, dealing with your fundamental question, this is a very high risk business at this stage. The United States has lost much of the con-

sumer electronics industry. It will take a huge capital investment to get in it. If the companies are unsuccessful, they will lose that money and probably never be able to reenter it again. There is risk in trying to reenter it now, and it just is not happening and just is not going to happen.

Senator PRESSLER. Well, then, to reask this fundamental question, what if we just do nothing? What would you project will happen?

Dr. FIELDS. I will give you a qualitative projection. What I believe will happen if we do nothing is that companies in the United States that are foreign owned will assemble high definition televisions and VCRs and sell them to the public in the United States that while the cases and the large sort of fragile components will come from U.S. sources, the semiconductors and many of the high technology components will come from abroad.

The economy of scale enjoyed by companies producing them abroad will hurt U.S. companies and semiconductors in high density recording and so on. How much it will hurt them remains to be seen. The AEA's projections show a very large loss in market share of semiconductor production and PC production. If the U.S. does not capture a reasonable share of the HDTV business—and Pat Hubbard can go over that if you like——

Senator PRESSLER. So, what we are really talking about is if we do not do something, whatever that something is, or if somebody does not do something, we are going to lose all of this to Japanese companies.

Dr. FIELDS. I personally did not mention Japan uniquely because there are a number of other countries involved in this and, again, the "we" is industry and government in some mixture which is now debated.

Senator PRESSLER. Which countries are those?

Dr. FIELDS. There are investments in HDTV in France and Germany and many other countries, Korea.

Senator PRESSLER. So, France, Germany, Korea would take over this market instead of American companies because of their ability to act in a more—now, why can those companies do it if ours cannot?

Dr. FIELDS. Well, I do not want to get into that prognosis. I think that would be best left for some of the other witnesses. Suffice it to say that there has been huge investment abroad both on the part of the government, governments abroad, and on private companies abroad.

Senator PRESSLER. Because they have monopolies or they have government subsidies. I think it is very good that we understand or that we try to understand today—and I have got other committees I have to run to and get back to—the real fundamentals about this because I have found that there is not much concern or much awareness across the country that there are many—that high definition TV is almost secondary to the other related issues involved here, and I think it is a very important basic question, but I am not yet—I am always a little puzzled at how these other companies can come into our market and do so much better than some of our companies can, and usually the answer is that they are subsidized or they can operate as a monopoly.

If that is true we should get an equal playing field somehow. That is the best word in Washington these days is an equal playing field. That is what everybody wants, which usually means some kind of protection.

But the point is I think we need a better understanding—and maybe you are not the witness to volunteer the views. But we really need to wrestle with the fundamentals of what this is. Why is American industry not doing it right here in our own country? And perhaps we will hear that from some of the other witnesses. But that is what I am really trying to get at.

Dr. FIELDS. Well, that is the next panel, and they will be able to answer your questions.

Senator PRESSLER. Let me just ask—it is assumed the United States has lost its lead in consumer electronics industry and that we are still ahead in computer technology, although the Japanese may be gaining on us there, and the European nations have joined together to initiate a major effort in that area. Why should we not admit defeat on this HDTV issue and instead concentrate our efforts on an area where we are already ahead, the computer industry?

Most experts believe that the computer and television technologies will converge in the future. Would we not be in a better position if we are the world leader in computer expertise?

Dr. FIELDS. I do not view it as an issue of either/or. The fact is that the Office of Science and Technology policy has put together a plan which will be soon presented to the public, of course, and to the Congress on high performance computing showing, not only how important that is, but also what can be done about it.

The issue is to go top down and bottom up for bottom up, the strongest driver is high definition television because of the volumes for top down. There is a supercomputer problem, and we really just cannot do one or the other.

Senator PRESSLER. Thank you.

Senator BRYAN [presiding]. Thank you very much, Senator Pressler.

Senator Bentsen.

Senator BENTSEN. Thank you, Mr. Chairman. Time and time again we hear about some major scientific breakthrough made by American scientists, and then we find some other country has taken that technology and adapted it to commercial production before we were able to commercialize it. We look at memory chips and know that they were developed by Texas Instruments and AT&T Laboratories and yet today I think something over 80 percent of those microchips are further refined by the Japanese and manufactured by them.

We say read my lips and they say read my chips, and they do a pretty effective job of that. Even the Defense Department is buying them.

We think about American scientists at Raytheon inventing the microwave, and now we find Asia and Europe manufacturing practically all of them.

We think about the breakthrough on VCRs not to mention television sets which were invented in this country. Not one of them is made in America today.

I think about DARPA and what it invested in numerically controlled machine tool technology and machinery. Now 75 percent of these machines are produced in Europe and Asia. And that is what is worrying me, trying to see what we can do to establish and exercise some leadership.

It is not just that the Japanese have made more scientific breakthroughs. They have had less than 10 Nobel prize winners. We have had over 150. But Japenese companies and others around the world today have an advantage. We see business and government in partnership. I do not want to see an industrial policy where government sets policy, but I do want to see a situation where business leads and then, if necessary, government helps to accomplish an objective.

Yet, what worries me is the money that is spent in DARPA today, as I understand it some $30 million, has to be concentrated on the military aspects of new technologies.

I am also told that in addition to the applications you funded, that a vast number of other proposals were ripe in possibilities for additional research. I also look at DARPA's dilemma, what it is doing and wonder if there is some duplication in research. This is true especially with military applications of video receiver screens.

Is there an overlap in the research the military is doing in this area and what you are doing? Is there waste in not having a more coordinated, and funneled, and channeled approach?

Dr. FIELDS. I want to make a number of comments. First, let me deal with the small ones and then the large. In going through the proposals in our program in addition to inviting people from the Department of Commerce, NASA, NSF, and the FCC to go through that program, we also have people from all the services, the defense agencies, and the intelligence community just to be sure there was not overlap, there was not duplication, and there was not waste.

Insofar as I know, there is none. And I think at this stage we would know because we have done a very thorough job of looking at that. We very purposely fully are not investing our money in a way that would have produced anything that was absolutely unique to the military because then we would never, ever see the large production volumes that we would like to see in order to get costs down, which DOD needs.

Senator BENTSEN. While it is not unique to military applications, it is essential for the military. And that is true of a lot of our computer work, our work in artificial intelligence and networking and so on and so forth. Where it makes sense, we are purposefully trying to merge with a commercial base because it is good for us, it is necessary for us, and it is good for the country as a whole.

Leaving this aside for the moment because it is actually a smaller concern. I would like to mention a recent MIT study. If you have not yet been exposed to this study, which I think is called "Made in America," it deals with some of the fundamental issues of why we are in trouble. I

would urge that you the members of this committee and another committee get a presentation because, while HDTV is probably the largest potential product for our largest industry, namely electronics, it also is a symptom of an even larger problem. And while the MIT study breaks no new ground in exposing this problem, it does bring all the arguments together beautifully. It says here are the fundamental problems in manufacturing, production, and commercializaton in the country.

No one is more disturbed than I am if we invest in DARPA, and help some company or some university to develop the highest quality technologies in the world and then no one commercializes ithere. So what happens—it gets commercialized abroad.

One example is that I now can go to Tokyo and see fully composite office buildings. I can go to Iraq and see composite large-scale structures, a technology that originated in DARPA. But there is no such building in the United States.

Let me ask: If this technology is so important, why aren't you spending more of your own funds for it?

Dr. FIELDS. Well, we did redistribute funds to get a small program started. The fact is that if you look at the critical technologies that DOD is pursuing, DARPA's investment is in those critical technologies. That is in the sort of top of the list versus those that are lower, and I find that if we wanted to have a much larger program on this, I would have to stop work in artificial intelligence, all of it, stop work in electronics, all of it, stop work in parallel processing and super computers, all of it.

It is just ridiculous. It becomes a zero sum game, and that is not something anyone would want us to do. And yet, finding more is not easy at the moment.

Senator BENTSEN. Let me ask you another question—I know that I am running out of time. What do you think about having HDTV technology compatible with current TV sets or do you advocatetrying to reach out beyond that to make a more major breakthrough?

Dr. FIELDS. There is no conflict here. There are a number of technical ideas on the table, none of which I want to take the time now for, but I am happy to discuss privately because some of them are proprietary for making it possible for us to proceed into HDTV in a way that maintains compatibility with every one of these 160 million televisions.

Senator BENTSEN. That is not a limitation on the research.

Dr. FIELDS. And also gives you a lot of future expansion to what I will call this new digital world at the turn of the century. That—people know how to deal with that.

Senator BENTSEN. You think you can make a reasonable evolution into that?

Dr. FIELDS. Absolutely. There are a number of competing ideas for doing that. There are also some bad ideas where it would not work, but we will leave that aside.

Senator BENTSEN. Thank you very much, Mr. Chairman.

Senator GORE. [Presiding]. We can have a second round of questionswith this witness if the Senator wishes to. Senator Bryan.

Senator BRYAN. Thank you very much, Mr. Chairman. Dr. Fields, you make a very persuasive argument in terms of the significance of this technology, not in the narrowest perspective of improving one's ability to seek quality television, but in terms of the kind of requirements that will generate and spawn new industries in which we all want to have American technology to have a major stake at that.

You have told us who some of the players are and we also know that Japan, France, Germany, and South Korea are potential producers. Hopefully, the United States will also be there. Rank us, where are we in terms of reaching that finish line?

Dr. FIELDS. In my view in terms of technical quality of technology in the laboratory, I think we are number one. In terms of development commercialization, getting it out of the laboratory, we are probably last on the list at the moment.

Senator BRYAN. And where does that put us in terms, of that ultimate breakthrough if we are last in adapting the technology developed in the laboratory to the production of a product? Where does that put us—are we a year, two years, three years behind, or can't you really quantify it on a time line?

Dr. FIELDS. Well, rather than dealing with how far behind we are, let us talk about how long it would take to catch up. I mean, that is subtly different. The fact is I believe that with a concerted national effort within a few years, three to four, you would see some very exciting products coming out in this country. But that does require a concerted effort that starts now.

One of the reasons that we have not tried any exotic organizational forums like consortia for getting our program going is that it takes a year or two to get a consortium going, and so we have tried some other organizational schemes that could get going now since we do not have all of the legal agreements that have to be made, but I think it is a three or four year story.

Senator BRYAN. I think you indicated that your greatest concern, if I understood your testimony, is not whether the administration will get its act together or the Congress respond appropriately, but whether the industry will be able to get itself together to speak. Are you talking about with a single voice? Are you talking about having an organizational structure through which the industry can articulate its views as opposed to some type of collegial arrangement, or as opposed to an individual, corporate or private sector entrepreneur?

Dr. FIELDS. It does not have to be through a single voice. The issue is few enough voices to make a commitment so that we can know in the government that whatever we do will be matched, and I do not mean equally matched, but matched conceptually by what is going on in industry so we do not waste our efforts and our resources.

If we agree to do a certain set of things and industry in fact does not commit to do the complimentary set of things, it just will not work.

Senator BRYAN. Dr. Fields, at present how do you approach that? You have seemed to imply that there are other things that you would like to be able to do, but you have some finite resources. You prioritize, presumably, what you are doing with your resources. How do you interface with industry now, if at all?

Dr. FIELDS. Well, we do interface with individual companies, the American Electronics Association, the Electronics Industry Association, the Semiconductor Industry Association, and the Semiconductor Equipment Manufacturers Association, so there is a lot of interaction back and forth, and you should know, as you will hear from subsequent panels, that they are working very, very hard to get this organization in place. I just hope it does not take too long. So, there is good will on both sides.

Senator BRYAN. Maybe you could give us some historical insight in terms of how you developed your priorities in the past. You probably talk with those same private sector organizations that you just outlined to us. Do you say to them, look, from our perspective there are two or three or four technologies that are terribly significant. What role will you play and make your decision based upon their response?

Dr. FIELDS. We have had a totally open and I think very friendly conversation both ways over the last year and, in fact, we call that the proposals we have received do make commitments from the individual companies for investments that are equal to and in some cases or in many cases greater than ours. And so there are industry commitments, but there are even larger ones coming later in manufacturing. That is really what I am concerned about.

Also, you talked about issues of priority. One thing that has not yet been faced is the Defense Department's role in all of this. The question is not a matter of "Is DOD going to do something that is so unique that it does not help the industry as a whole?" That is not the case and that is not the problem.

The issue is just what degree should DOD get involved. This is not just the defense problem, although it is a defense and national security problem. It is also a national economic problem. Maybe we should not pay all the bills. Maybe someone else should pay part of the bills and we should pay part of them in some pro rata fashion. That just never has gotten settled.

As you know, the Defense Department has some serious financial problems at the moment, and we just cannot do everything, and so we would not mind some partnership in this.

Senator BRYAN. What kind of model would you suggest? If you were scripting the bill, what would you suggest?

Dr. FIELDS. Well, let me again leave that until Secretary Mosbacher comes out with his. Mine will include the administration's suggestion on how to organize things.

Senator BRYAN. Do you have any indication, Dr. Fields, as to when we might see that?

Dr. FIELDS. Well, when he testified before Congressman Markey's committee on the 8th of March, he promised that by the 1st of July—and I am assuming that is his schedule.

Senator BRYAN. In the meantime, we are just kind of in a holding pattern to wait to see what that may look like?

Dr. FIELDS. In the meantime we are trying to get our program off the ground in as effective and efficient a manner as possible, and we are hoping the Commerce Department to the extent they would like some technical assistance in getting that plan together.

Senator BRYAN. Prior to Secretary Mosbacher's taking office, what kind of communication or coordination did you have with the Department of Commerce?

Dr. FIELDS. Well, it really was not as rich as it is now. We have for many years worked with NIST previously, the National Bureau of Standards. We fund a good deal of work there because we have a lot of confidence in their abilities as bench scientists to do scientific work for us.

But at the department level we really did not have much communication. It is much, much better now, and I am pleased about that.

Senator BRYAN. Thank you very much, Dr. Fields. Thank you, Mr. Chairman.

Senator GORE. Well, thank you. Just to follow up on that last set of questions, it is your understanding that the executive branch effort in this field is being led by the Commerce Department, correct?

Dr. FIELDS. Yes, absolutely.

Senator GORE. So, Secretary Mosbacher is formally in charge of the U.S. government position?

Dr. FIELDS. That is my understanding. I have seen no written document supporting that, but he has told me that he is in charge and the President asked him to do it. I will certainly accept his word. There may be a formal document I have not been exposed to.

Senator GORE. Well, I am really worried, as I tried to indicate earlier, that others within the executive branch are bound and determined to prevent him from even suggesting the kind of dynamic role for the federal government that most people feel is necessary.

Dr. FIELDS. Well, again, that is something he is going to try to have to face and presumably is facing. If there is a problem, the Defense Department is supporting him, and I am sort of pleased we have worked out this partnership.

Senator GORE. Is the U.S. government/private enterprise arrangement in this area unique? Has anything like that been done before?

Dr. FIELDS. No. We have many joint ventures with industry that are as complicated or more complicated than this in the areas of supercomputers and artificial intelligence and superconductors where we are supporting three consortia at the moment. No, this is business as usual for us.

Senator GORE. In fact, RCA was created in such a fashion.

Dr. FIELDS. If you want to go back much further, that is absolutely right.

Senator GORE. Where is RCA today?

Dr. FIELDS. Next question.

Senator GORE. Well, you know, we could learn a great deal, Dr. Fields, by having you herer all day long, but we have several other witnesses and so we will forego that opportunity.

I would just like to say on a personal note as someone who has worked very hard to understand this whole issue and to determine what ought to be done, that I think we are very fortunate to have you in the position you are in. I hope that the Commerce Department gets its act together, or more accurately that the rest of the executive branch gets its act together.

Incidentally, this subcommittee will be having hearings very shortly on the supercomputer industry which includes both supercomputers and massive parallel computers. I am introducing legislation this week which includes an "interstate information superhighway network" and other provisions. We will have you back at that next set of hearings to discuss that.

Thank you very much for getting us off to a good start.

Dr. FIELDS. Thank you.

Senator GORE. I would like to invite the members of our first panel to come up. This panel is made up of manufacturers. First, Jerry Pearlman, President and CEO of Zenith, a corporation in Glenview, Illinois; second, Pat Hill Hubbard, Vice President for Science and Technology Policy at the American Electronics Association, accompanied by John Stern; Mr. Donald Johnstone, President and CEO of Philips Consumer Electronics from Knoxville, Tennessee, accompanied by Dr. Larry French; and Mr. William Connolly, President of Sony Advanced Systems in Teaneck, New York.

Let me say that your prepared statements will be included in the record. If you wish to proceed with a summary of your statements, we would request that you do that because we have such a lot of ground to cover.

We will begin, Mr. Pearlman, with your presentation as CEO of Zenith Corporation. You have a good deal to offer us by way of insight and information, and we invite you to proceed at this time.

STATEMENT OF JERRY PEARLMAN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, ZENITH CORP.

Mr. PEARLMAN. Thank you, Senator. I would like to thank the committee for inviting me to share the views of Zenith on how the key issues and decisions needed to facilitate the United States being a worldwide leader in high definition television could be addressed.

I think Dr. Fields has already summarized that there is really significant leadership in the lab, and I think that we have a great opportunity to build on this leadership in a lot of these areas and become a major player in high definition TV—also a major player in high resolution computer displays and other related product areas.

Only a supportive national environment, however, will enable the U.S. to translate our computer component technology and TV systems skills into ATV intellectual property and production leadership.

I think that the central issue in the debate on HDTV today is focusing on what should the government do and then how should the industry be able to work together. I think the goals of the government involvement are twofold in my judgment: first, to preserve and add to what is left of the U.S.-based electronics components industry, which is a key part of this industrial food chain that you have been discussing. And the second government key objective should be to facilitate the development of a world leadership position in key high definition components, receivers, displays, and related areas. These are the technologies that will support the U.S. HDTV in computer displays, the technologies that will transfer to other product areas, and the technologies that we can export.

The semiconductors that you have been talking about when Dr. Fields was up here, we believe will represent about 20-25 percent of the value added of a high definition television receiver. The display portion of the receiver will be about 50 percent of the value added, and it is the display portion that will initially most rapidly cross over into the computer arena. Both semiconductors and displays require very large capital investments when we reach the production stage.

There is no question that industry must take a leading role, but we cannot do it on our own. The government must create the supportive environment for industry to do its part and be willing to make its investments. And to do so, I think the government must quickly address a number of key issues, particularly R&D funding, standards, and fair trade.

I would like to address each of the three in order.

First, starting with R&D funding, there is a clear industry and government consensus on the need for government supported U.S. high definition TV research and development. AEA in the study announced last week pointed to a need for $100 million of annual government investment in R&D.

We all agree that the $30 million initially announced by DARPA will only scratch the surface. $100 million a year for three or four years matched by an equal amount from industry or equal or greater amount is about the amount that we believe is required.

I can assure you that industry is ready, willing, and able to make these investments. The Japanese and European governments have been investing in HDTV technology for years, and now is the time for the U.S. government to do the same. But we are not asking for a handout. Zenith has long been on record as saying there should be strings attached to government R&D funding, and the government should get paid back. Today I would like to introduce a new funding concept for you to consider.

Not too many industries come to Washington and say tax us to help pay for what we need. But that is exactly what Zenith proposes. We urge Congress to amend the Trust Fund Code of 1981 to create a new

trust fund to pay for the federal cost portion of HDTV research and development by U.S. companies. Ten such trust funds already have been established. Under the code these trust funds may be structured for a fixed or indefinite period. Zenith suggests a trust fund with a fixed term of three to four years for HDTV.

This new HDTV trust fund should be fueled by a $5 excise tax on color television set sales in the United States. That would raise $100 million per year. The trust fund would satisfy the acknowledged need for subsidized HDTV research without placing any additional strain on the national budget, although I do understand it sounds like a duck and quacks.

HDTV trust fund disbursement should be administered by the Commerce Department using DARPA as the R&D program manager because both Commerce and the Defense Department have a vital interest in the development of a strong domestic HDTV industry.

An excise on conventional TVs, this excise tax should stop after three or four years, but it could be replaced with a self-replenishing fund on HDTV sales that could be structured in a way to encourage U.S. content and production. We have a number of specific suggestions in that area, but they are not included in this material.

The second key issue where I think government action is required is standard selection and licensing. We agree with the AEA's conclusion that the transmission standard is a critical component to U.S. leadership in HDTV and related technologies. But unlike the AEA, we do not think the government needs to buy out all of the technology from each company that is competing to have its technology chosen as the transmission standard. Rather, and quite simply, the FCC should stipulate that any systems contender must agree to the licensing rules promulgated by the Commerce Department. The Commerce Department should then promulgate rules that require licensees to commit to U.S. content particularly for semiconductors and displays.

The transmission standard will be the engine that will drive HDTV and drive the control of patents and key component technology. The U.S. standards should assure that royalties paid to intellectual property holders create a positive balance of trade for the United States. Because the choice of transmission standard will either feed or bleed the U.S. industry, we must not rush to choose a standard. From being far behind two years ago, U.S. technology is rapidly catching up with the Japanese and the Europeans. Our technology ideas are best suited for the U.S. over the air and cable delivery systems. We just need a little more time to reach the prototype stage.

The government must require in the standards are that the U.S. standards provide for world competitive HDTV performance. To avoid compromises and promote a strong U.S. HDTV industry, testing and evaluation of all proposed systems must be done with great care and will require sufficient funding from the government and industry so that the experts can define the problem areas and assure compete and uniform testing.

For example, the standard setting process must require that those who propose phasing in an advanced TV system in steps demonstrate the final step of their proposal and undergo full testing and evaluation of that final step. The government should demand the testing of transmission technologies include extensive evaluation of a number of things, of proposed systems via cable and through existing scrambling systems, of small screen as well as large screen, of digital signal processing and signal integrity and robustness.

The standard setting process must address issues related to the transfer of technology to other businesses. Transmission systems that need more than one HDTV channel, for example, transfer very poorly to VCR technology.

The standard must be selected to address our nation's expected needs well into the next century. Zenith's broadcast system just to put in a plug, of course, because of our unique usage of spectrum will actually free up broadcast spectrum for other services 20 years down the road.

The third key issue is the area that calls for government action is in assuring a fair trade environment, and Dr. Fields mentioned this on one of his higher priority lists. U.S. industry has the technology to succeed plus the ability and desire to commercialize these technologies on its own. The principal barrier that keeps American companies from making massive new commitments of resources to the consumer electronics business is the lack of opportunity for profitability that the market has demonstrated in the past two decades.

Television unit sales volume in the United States has set new records in each of the last 10 years, and for almost every one of the last 20 years, yet U.S. companies one by one close their doors, liquidated or sold out at losses because our market became the world's dumping ground for electronic products. Loopholes in the dumping law and lack of aggressive enforcement have allowed our market to become an incremental volume opportunity for Far Eastern producers with closed home markets. They have used our market to build up the scale in their plants and to push down their costs.

These Far Eastern producers have been willing to operate their U.S. businesses at fully accounted losses for years and have regularly reported these losses to the International Trade Commission. Their unrelenting pressure on pricing and profitability drove most of the U.S. companies not only out of R&D but out of business.

Because of Zenith's substantial market share, premium price position and low cost base, we were able to survive, although we got pushed into the red in 1987. We have continued to invest in R&D but at a much lower rate than we would have liked. We have invested tens of millions of dollars in our high resolution computer picture tube technology which we are transferring to HDTV and in our own unique world class broadcast transmission system.

You may know that we formed an R&D consortium with AT&T to refine our transmission system and develop all the key custom microcircuit building blocks needed to produce HDTV receivers. AT&T also has invested tens of millions of dollars in world leading positions in

many of the specialized technologies required for these critical ICs. We are committed to going forward on both our HDT transmission and picture tube R&D efforts, but we could go much faster with government support, and that is why we developed each of those areas into proposals to DARPA.

The R&D funding alone is not enough unless the industry is profitable, we cannot continue to make appropriate investments in HDTV. We must have fair and tough trade laws, and they must be vigorously enforced. Congress still needs to strengthen anti-dumping laws, make them as tough as the European community.

Most of what needs to be done requires no legislation. It just needs tougher administration and regulation at the Commerce Department. Most of the other changes would create a more conducive environment for industry in the HDTV are covered in legislation introduced last week by Senator Kerry, earlier by Congressmen Ritter and Levine, bills that would modify antitrust and tax code, encourage direct relevant government procurements.

And the last area I want to stress the need to grant preferred supplier status to U.S. producers in filling government R&D and production contract needs and HDTV and in high resolution computer displays.

The opportunity is here. U.S. industry can be a worldwide leader in HDTV. We must export key technologies not import them.

We must earn royalties not pay them. We have the technologies and the interest, but we must be sure that we have an opportunity to capitalize profitably on the major investments that are needed.

The government can provide that by creating a supportive environment. Thank you, Senator.

[The statement follows:]

STATEMENT BY
JERRY K. PEARLMAN
CHAIRMAN AND PRESIDENT
ZENITH ELECTRONICS CORPORATION

TO THE
UNITED STATES SENATE
COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY AND SPACE

Thank you, Mr. Chairman, for inviting me to share the views of Zenith Electronics Corporation on how the United States can be a worldwide leader in high-definition television (HDTV).

The United States is already a technological leader in many of the areas required for worldwide success in HDTV, including advanced integrated circuits and video signal-compression techniques. The U.S. also is a leader in the advanced picture tube technology needed for low-cost high-resolution video displays.

The U.S. has a great opportunity to build on its leadership in these areas and become a major world player in HDTV, high-resolution computer displays and other related product areas. Only a supportive national environment, however, will enable the U.S. to translate our computer component technology and TV systems skills into HDTV intellectual property and production leadership.

A central issue in the debate about HDTV these days -- and one of the main reasons we are here today -- focuses on what the government should and should not be doing in the HDTV area.

Simply put, the goals of government involvement should be:

- To preserve and add to what's left of the U.S.-based electronic components industry, which is a key part of the industrial "food chain"; and
- To facilitate the development of a world-leadership position in key high-definition components, receivers, displays and related areas -- technologies that will support U.S. HDTV and computer displays, technologies that will transfer to other product areas, and technologies that we can export.

There is no question that industry must take a leading role. But we cannot do it on our own. Government must create a supportive environment for industry to do its part. And to do so, government must quickly address a number of key issues, particularly R&D funding, standards and fair trade.

Let me address these three areas, starting with R&D funding. We finally sense a consensus on the need for government-supported U.S. HDTV research and development. The American Electronics Association, in its HDTV study announced last week, pointed to a need for government investment in R&D. We agree that the $30 million initially announced by DARPA (the Defense Advanced Research Projects Agency) will only scratch the surface; $100 million a year for three or four years, matched by an equal or greater amount by industry, is required. I assure you that the industry is ready, willing and able to make these investments.

Japanese and European governments have been investing in HDTV technologies for years. NOW is the time for ours to do the same.

But we're not asking for a handout. Zenith has long been on record as saying that there should be strings attached to government R&D funding and that the government should get paid back from future successes of HDTV-related research.

Today, I'd like to introduce a new funding concept for you to consider. Not too many industries ever say, "Tax us to help pay for what we need." But that's exactly what Zenith proposes.

We urge Congress to amend the Trust Fund Code of 1981 to create a new trust fund to pay for the federal cost portion of HDTV research and development by U.S. companies.

Ten such trust funds have already been established. Under the Code, these trust funds may be structured for a fixed or indefinite period. Zenith suggests a trust fund with a fixed term of three to four years for HDTV.

This new "HDTV Trust Fund" would be fueled by a $5 per unit excise tax on color TV set sales in the U.S. It would raise $100 million per year. The trust fund would satisfy the acknowledged need for subsidized HDTV research and development without placing any additional strain on the national budget.

HDTV Trust Fund disbursements should be administered by the Commerce Department, using DARPA as the R&D program manager, because both Commerce and the Defense Department have a vital interest in the development of a strong domestic HDTV industry.

The excise tax on conventional TVs should stop after three or four years, but it could then be replaced with a self-replenishing fund based on HDTV sales and structured to encourage U.S. content and U.S. production.

The second area where government action is required is in standards selection and licensing.

We agree with the AEA's conclusion that the transmission standard is a critical component to U.S. leadership in HDTV and related technologies. But, unlike the AEA, we don't think the government needs to buy out all of the technology from each company that is competing to have its technology chosen as the transmission standard. Rather, the FCC should stipulate that any system contender must agree to the licensing rules promulgated by the Commerce Department. These rules should require licensees to commit to U.S. content, particularly semiconductors and displays.

The transmission standard will be the engine that will drive HDTV and drive the control of patents and key component technologies. The U.S. standard should assure that royalties paid to intellectual-property holders create a positive balance of trade for the United States.

Because the choice of the transmission standard will either feed or bleed the U.S. industry, we must not rush to choose a standard. From being far behind two years ago, U.S. technology is rapidly catching up with the Japanese and Europeans. Our technology ideas are best suited for the U.S. over-the-air and cable delivery systems. We just need a little more time to reach the prototype stage.

The government must require that the U.S. standard provides world-competitive HDTV performance.

To avoid compromises and promote a strong U.S. HDTV industry, testing and evaluation of all proposed transmission systems must be done with great care and will require sufficient funding for government and industry experts to define problem areas and to assure complete and uniform testing.

For example, the standard-setting process must require that those who propose phasing in an advanced TV system in steps demonstrate the final stage of such a proposal and undergo full testing and evaluation of the final stage.

The government should demand that testing of transmission technologies include extensive evaluation of proposed systems via cable and through existing scrambling systems, of small-screen as well as large-screen displays, and of digital signal processing and signal integrity/robustness issues.

The standard-setting process must address issues related to transfer of HDTV technology into other businesses. Transmission systems that need more than one HDTV channel, for example, transfer poorly to VCR technology.

The standard must be selected to address our nation's expected needs well into the next century. Zenith's broadcast system, for instance, because of its unique spectrum compatibility characteristics, will actually free up more broadcast spectrum for other services in 20 years.

The third and final area of government action is in assuring a fair trade environment.

U.S. industry has the technologies needed to succeed, plus the ability and desire to commercialize them on its own. The principal barrier that keeps American companies from making massive new commitments of resources to the consumer electronics business is the lack of opportunity for profitability that the market has demonstrated for the past two decades.

Television unit sales volume in the United States has set new records in each of the last ten years and for almost every one of the last twenty years. Yet U.S. companies have, one by one, closed their doors, liquidated or sold out at losses because our market became the world's dumping ground for electronics products.

Loopholes in the dumping laws and a lack of aggressive enforcement have allowed our market to become an incremental volume opportunity for Far Eastern producers with closed home markets. They have used our market to build up the scale of their plants and push down their costs. These Far Eastern producers have been willing to operate their U.S. business at fully accounted losses for years (as they have regularly reported to the International Trade Commission). Their unrelenting pressure on pricing and profitability drove most of the U.S. companies not only out of R&D, but also out of business.

Because of Zenith's substantial market share, premium price position, and very low cost base, we have been able to survive, although we were pushed into the red in consumer electronics in 1987. We have continued to invest in R&D, but at a much lower rate than we would have liked.

We have invested tens of millions of dollars in our high-resolution computer picture tube technology, which we are transferring to HDTV, and in our unique, world-class HDTV broadcast transmission system. As you may know, Zenith has formed an R&D consortium with AT&T to refine our transmission system and to develop all of the key custom microcircuit building blocks needed to produce HDTV receivers. AT&T has tens of millions of dollars invested and world-leading positions in many of the specialized technologies required for these critical components.

We are committed to going forward on both our HDTV transmission and picture tube R&D efforts, but we could go much faster with government support. That is why these two efforts were developed into proposals to DARPA. But R&D funding alone isn't enough. Unless the industry is profitable, we cannot continue to make appropriate investments in HDTV.

We must have fair and tough trade laws -- and they must be vigorously enforced -- to assure a strong American presence in the coming era of HDTV. Congress still needs to strengthen antidumping laws, making them as tough as those of the European Economic Community. Much of what needs to be done requires no new legislation; it just needs changes in administration of the law.

Most of the other changes that would create a more conducive environment for industry investment in HDTV are covered in legislation introduced last week by Senator Kerry and earlier by Congressmen Ritter and Levine -- bills that would modify antitrust and tax codes, and encourage and direct relevant government procurements. In that last area, I want to stress the need to grant preferred supplier status to U.S. producers in filling government R&D and production contract needs in HDTV, high-resolution computer displays and other areas.

The opportunity is here. U.S. industry can be a worldwide leader in HDTV. We must export key technologies, not import them, and we must earn royalties, not pay them.

We have the technologies and the interest, but we must be assured that we also have an opportunity to capitalize profitably on the major investments that are needed. The government can provide that by creating a supportive environment.

Senator GORE. Thank you very much. We will save our questions until the panel members have completed all of their statements. Pat Hill Hubbard, Vice President for Science and Technology Policy of the American Electronics Association. You have worked with the Commerce Committee before and we appreciate you returning here. You are accompanied by John Stern, Vice President for Asian Operations of the AEA, and we appreciate your presence Mr. Stern.

Ms. Hubbard, please proceed.

STATEMENT OF PAT HILL HUBBARD, VICE PRESIDENT FOR SCIENCE AND TECHNOLOGY POLICY, AMERICAN ELECTRONICS ASSOCIATION; ACCOMPANIED BY JOHN STERN, VICE-PRESIDENT FOR ASIAN OPERATIONS

Ms. HUBBARD. Thank you very much. I want to thank you for your invitation to testify today on developing a national strategy for how the United States can get into high-definition television.

We look at it more broadly. We talk about developing a U.S. advanced television industry. The American Electronics Association is a 46 year old trade association, nonprofit trade association. We have about 35,000 companies nation wide. We have 45 U.S. research universities who are also associate members. Our members design and manufacture and conduct research in electronics, electronic components and related information technology products.

As you accurately said, I am responsible for science and technology policies and education. Most of my efforts this past year, in fact, almost a year ago today, when our industry came to Washington on our annual capital caucus to bring our issues to you to discuss them, I have been working to assist an industry wide leadership effort to try to get this country back into the consumer electronics business via ATV.

I have to say that when I joined the association some 10 years ago, I was recalling that my speeches at that time had the statement that by the year 2000 we hoped to move as an electronics industry from the sixth position, which we were in 1979, to number two. I was wrong by 15 years. We are now number one. We are three times larger in employment than autos and nine times that of the basic steel industry. We are more importantly the tool maker for many other industry segments. We drive, we think, improvements in quality and productivity that are essential.

Electronics, computers, telecommunications, et cetera has catapulted us clearly from the industrial age into the age of information. Electronics will underpin as well as drive the global economy in the 21st century. The U.S. and its electronics industry will either be in the front seat or a passenger watching other countries pass on by, and we certainly think the front seat is a preferable position. And that actually we, therefore, are somewhat of a strategic industry important to the U.S. economy and, as Dr. Fields so eloquently spoke, certainly parts of our industry are essential to national security.

Technology is driving all economies of the world, X-ray lithography, coal fusion, superconductivity, supercomputing, all have come about, really, within our recent memories. They will be very important as we move into the future.

The long-term leadership of the U.S. electronics industry, unfortunately, is under serious threat today. Our country has an uncertain response to this changing international environment. We have an extremely high cost of capital. It is fundamental in all discussions where we are concerned. Our cost of capital is four times that of Japan. And we have a declining situation and educational standards, one that while we may coast through for the next five years will hit us square between the eyes or shortly thereafter.

Between 1984 and 1987, we lost market share in 10 electronics segments. Global economies of scale that are driven by in-use consumer products—I never really thought that would happen—are becoming increasingly important in achieving competitiveness. One-third of our electronics trade deficit with Japan today, it is around $7 billion, can be laid at the feet of the lack of U.S. presence in consumer electronics. ATV, advanced television, includes high definition television, really offers a limited, once-in-a-lifetime gateway for U.S. reentry. There are new market opportunities that become available from ATV technologies and there are many spin-offs. You can get a different price range depending on how you count them, but conservatively, from $5 billion to $20 billion a year by the year 2000.

And there is a downside, and it is probably the reason why the American Electronics Association is involved in this. If this were just simply a market opportunity we would certainly go on about it many other businesses. On the downside, however, should U.S. companies not participate, ATV offers a pathway for other countries to capture U.S. market share in non-consumer electronics fields, such as and in particular, computers, semiconductors and telecommunications. And it is important to emphasize that we are involved in the ATV issue for very different reasons than the esteemed panel here today. We are different in the public debate, which looks most commonly at HDTV as simply an improved television picture. You spoke about that very articulately. It is really far, far more than that. It is such a fundamental imaging technology. And most agree that ATV will bring on eventual merger of digital-based communications, computer and entertainment into some very many interrelated high-resolution technologies and markets. This kind of industry we really think may well underlie the world's economy and certainly shape its political organizations in the 21st Century.

Most of you are familiar with the concept of the food chain that is particular to our industry. When one part is crippled the others feel pain. And the loss of consumer electronics has been certainly an example of one of those situations. Through the loss of consumer electronics, many other issues have come forth. The present state of semiconductor technology, for example, many attribute to a lack of consumer electronics products. Certainly, that is, as we understand, one reason why we are having some difficulty, at least from the Japanese perspective in expanding our export markets and semiconductors to Japan.

Should we not participate, then the impact is really two-fold. And again, Dr. Fields, eloquently described it. We will have not only a loss of market volume in present consumer electronics, but in the non-consumer, but we will have a loss of technological know-how in other parts of the food chain. And these losses again are going to lead to losses in other fields.

We did an economic impact study. We looked at the impact on particularly semiconductors and personal computers and we looked as far out as 20 years from now, and it is our belief, at least there is a trend this way, that we need to get in and gain 50 percent of the U.S. HDTV market in order to retain our present market share in personal computers and semiconductors. And if we do not gain that 50 percent, we believe we will stand to lose as much as 50 percent. We will essentially be a non-player.

Senator GORE. Just to interject one brief point. What percentage of the television market do we now have?

Ms. HUBBARD. We have, what is it 10 percent, Jerry?

Senator GORE. That is the figure I have, 10 percent. And you are saying we have to have what percent?

Ms. HUBBARD. Fifty percent of the ATV market, which is a whole other ball game than just colored television. It is a much more challenging situation.

Senator GORE. Excuse me for interrupting.

Ms. HUBBARD. That is okay. Again, I think one thing that commonly we do not talk about or we do not think very much about is that the loss in these non-consumer markets will have an impact on job loss in these non-consumer electronics markets.

Most U.S. workers, as you have heard again from Dr. Fields, in the TV business now assemble glass and wire into wooden boxes. There are certainly some exceptions. Thomson and Philips, in particular, are known to do R&D and manufacturing here. But the point is that screwdriver factories where you assemble foreign components use significantly different skills and talents in their workers. They command very different wages and they create far less secondary and tertiary support jobs. I think an assembly worker creates about 1.8 secondary/tertiary; an engineer who designs, et cetera, creates eight secondary and 24 tertiary jobs.

So there is a ripple effect that takes place and it is definitely going to be felt on the American job market. There is grim joke in the U.S. television industry today that Muse, the name of the Japanese HDTV broadcast standard, is an acronym for massive unemployment strikes engineers. I hope that that is just one of those things that never comes to the fore. But it certainly emphasizes the importance of the issue.

We lack the technologies. We lack the related manufacturing marketing supplier and distribution infrastructure. We face multinational consortia abroad, in Europe and Japan. They have substantial funding from their governments, both for R&D, as well as for what we call pump priming or building consumer demand. These are, also in some cases, they have benefit of home market protection.

Consumer electronics is a manufacturing business. We are wonderful at technology and innovation. We are not so wonderful in world class at commercializing. We have a different manufacturing infrastructure in this country than some of the vertical companies abroad. We are weak in technologies as you have heard. Our cost of capital is very high and in this situation, uniquely so. It is going to require a long time horizon. The return on investment will be low probably through the 1990s. It is necessary through the 1990s, however, in order to get return in the year 2000.

All of this just does not fit the criteria, the investment criteria, for U.S. private industry, venture capitalists, institutional investors. No one that we can find today. So what we have done is we have studied the issue for nine months. We got tired of studying the issue. Also, you here were asking us for a strategy. 36 of our companies then moved to action as they are want to do upon the right occasion. And they funded a study, a comprehensive study, cost almost $.5 million, frankly, from the Boston Consulting Group, and it has been an incredible comprehensive look at the issue and what it will take to get the U.S. back into ATV, or into ATV and back into consumer electronics. And it includes plugging holes in the technology base, pursuing breakthrough innovations through world-class R&D and manufacturing, administering standards in a way that fosters development, making lower-cost capital available for manufacturing and investing in a pump-priming program.

Now there is whole series of activities which we are proposing, but basically just let me say that the best approach we think, we concur with the Boston Consulting Group in terms of their recommendations, that it is going to say not a single company, not a consortium of single companies together, but it is going to take and industry government partnership. This is not a subsidy program. It is a co-investment program. It is a jump-start program we are proposing. It is a catch-up. And we believe that it is, it points perhaps the way to compete globally in the marketplace with new partnerships between government and industry.

It is a uniquely American approach. It is not like the Europeans or the Japanese. But we think it has the key components. There may be certainly variations on those, but basically the key components are to propose $100 million a year to go on and fund those 49 key proposals that Craig Fields talked about at DARPA. $100 million a year for three years to invest a minimum of 50 million dollars over three years in NIST to develop prototype manufacturing process systems, test standards systems, and recommend to the FCC when that meets all of the United States need and advantages the United States.

Key to all of this is the set up of something we call an ATV Corporation. It is probably not the right name. But it is a management entity that would be basically chaired by industry, primary members would be industry, but there would also be government and academia on it. And its role would be to guide the overall ATV industry development. It would then, hopefully, if NIST either buys the licenses or the right to license, it would on NIST behalf provide licenses open to anyone at a price. The price would depend on how much R&D one did in this country, manufacturing, et cetera. Whether or not one bought U.S. semiconductors and whether or not one's home markets were open in a reciprocal way to the import of U.S. made ATV products.

It would administer what we are calling for from NSTC, trough NIST, $1 billion in loans. Those again are not subsidies. $500 million would be low-cost loans which would require a dollar-for-dollar investment. Another $500 million would be loan guarantees, all of which would be paid back. And any time industry puts a dollar, there is an assumption that it is going to get its money back and we assume that the government would as well.

We would look at the ATV Corp. as insuring that DARPA's R&D met commercial needs. That is certainly a concern. Also, and again Craig Fields mentioned there is a concern in the industry that history might repeat itself in terms of dumping, and therefore this body would sit and monitor and alert appropriate government agencies where there were signs of dumping. It would encourage pump priming and so forth.

I think that there are other aspects to the proposal but we think that at least we are pleased to be here and have it on the table. We hope it engenders a lot of discussion. We simply believe that it is imperative that this country get in now and make a beginning on a U.S. ATV industry.

Thank you.
[The statement follows:]

STATEMENT OF JOHN P. STERN, VICE PRESIDENT, ASIAN OPERATIONS, AMERICAN ELECTRONICS ASSOCIATION

Mr. Chairman and other distinguished members of this Committee, thank you for the opportunity to appear before you today. In 1984, the American Electronics Association, with matching funds from the Trade Adjustment Assistance Program of the U.S. Department of Commerce, became what we believe is the first U.S. trade association in any manufacturing sector to place a permanent office in Japan. Since 1984 I have been the Director of that office. Our office has assisted more than 8500 persons, Americans, Japanese and Europeans, in understanding U.S.-Japan electronics trade. According to Tokyo Business Today, an English-language business monthly, our office is responsible for an additional $7-$21 million in sales by U.S. electronics companies, a return of 14 to 42 times the cost of running the office. We have placed the first American on a Japan Industrial Standards (JIS) technical committee. We have published the first directory of U.S. electronics companies with permanent offices in Japan. There are now 392 such companies. We have lobbied successfully Japan's Congress, the Diet, to make Japan's career civil servants take positions we desired and to abandon positions we abhorred. My personal qualifications are stated in the attached biographical materials.

Japan's HDTV Effort

Japanese estimates of the size of the high definition television market in the next 15 years range from $27 to $81 billion dollars. Estimates may vary, but commentators in Japan all agree on the immensity of the market. Yet even though Japan is among the world's largest volume producers of television sets, with billions of dollars of research and production capacity already in place, the Japanese government has not been willing to bet the improved standard of living HDTV's will bring on the vagaries of free market competition. A spokesman for NHK, Japan's quasi-governmental television station, has stated on the record that the Japanese government spent $150 million on HDTV over a period of 25 years. An NHK documentary on HDTV aired in Japan on March 21, 1989 (a copy of which can be provided to your Committee) gave a figure of $750 million for the amount of assistance in the form of favorable tax treatment, loans and incentives, that the Japanese HDTV industry receives from its government. Japan is vigorously pursuing the licensing and promotion of HDTV through non-profit organizations as well as through for-profit companies. The reason that one of the world's largest TV producers in funding HDTV technology at such massive levels is that HDTV is not just TV: it is a new generation of imaging technology requiring the costly development of a variety of new disciplines.

"Hi-Vision Collision"

I would like to illustrate my point by showing a few seconds of a Japanese TV program on HDTV technology.[1] In this scene, an HDTV video image is frozen on the screen, then reproduced in hard copy form with the clarity and precision of a photograph. Books have been produced in Japan using high-definition graphics publishing. A postcard maker is selling postcards using photographs made with high-definition publishing processes. In another portion of the scene, a mail-order catalog shopper touches a wand to read the bar code under a jewelry advertisement and inputs some commands into a personal computer. Instantly the high-definition display shows how the jewelry might look on the shopper from a variety of angles and in a variety of styles. Since Japan's mail order shopping industry is dwarfed by America's, the U.S. would be a logical export destination for the Japanese makers of this technology. Japan envisions a variety of non-television uses for high-definition imaging technology, as illustrated in Attachment A. Pictured are, clockwise, conference, educational, family study, auto-navigational and medical uses of this imaging technology.

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[1] NHK TV Channel 1, March 21, 1989, "Hi-Vision Collision: A Triangular Report from Japan, the U.S., and Europe".

Japan's Future: "Giant Electronics"

Some Japanese producers of HDTV are already negotiating with some American semiconductor makers for a supply of specialized semiconductors for HDTV use. Nevertheless, Japan believes it is well on its way to leadership in microelectronics; now "giant electronics" is the technology Japan feels it needs to realize the full potential of high-definition imaging.

"Giant electronics", described in Attachments B, is the catch phrase a September 1988 Ministry of International Trade and Industry (MITI) report assigned to the various technologies it believed would have to be perfected to create ultra-thin, large display elements for use in book-size computers, optical publishing and other innovations. The scope of the project is reflected in the level of detail of Attachment C -- a cross-section of a giant screen involving glass, liquid crystal, materials, semiconductor and other technologies. One novel idea is to print circuit boards onto glass the same way newspapers are printed by a rotary press, as pictured in Attachment D. The report indicates that seven years and about $100 million would be needed to develop "giant electronics". Already the Key Technology Center, a joint government-industry consortium, is funding the development of "giant electronics" technology by a company whose shareholders include Hitachi, Sanyo, Asahi Glass, Sharp, and Casio.

HDTV in the U.S.

Some have argued that America can participate in the HDTV industry merely by allowing Japanese companies to manufacture in the U.S. In evaluating this argument, I would urge the Committee to consider employment and procurement trends. The willingness of Japanese subsidiaries in America to employ American minorities and women has received some media attention. However, of the 100 largest Japanese subsidiaries in the U.S., ranked by sales, it appears that less than 10 have Americans as chief executive officers. Indeed, as of January 1 of this year, to my knowledge not one of the 20 Japanese electronics subsidiaries with the largest sales in the U.S. had an American CEO. In December 1988, MITI, in its third annual survey of activities of overseas Japanese subsidiaries, found that 85.3% of the chief executive officers of Japanese subsidiaries in North America came from Japan. So did 74% of the financial managers, 64.3% of the personnel managers, 61.6% of the procurement managers, 59.4% of the research and development directors, and 52% of the sales managers. On the average, 67.9% of the executives and managers running Japan's manufacturing presence in North America are Japanese.

If American executives have had few opportunities with Japanese manufacturing in America, American suppliers may have even less. According to a July 1988 speech by an official of

the Japan External trade Organization (JETRO), of 118 Japanese-capital electronics manufacturing facilities in America, only 1 facility sourced 100% American. Only 21 facilities sourced 70% or more from American businesses. To focus on the potential pattern for HDTV sourcing, a November 1987 survey of 8 Japanese firms producing color televisions in North America, including Sony, showed that of a total of 18 key components in a color TV set, Japanese companies bought zero North American content for 14 components and less than 30% North American content for 3 components. Cathode tubes were the only component sourced in North America by most companies. Since the term "North America" includes Canada and Mexico, some North American sourcing may not be American sourcing (see Attachment E). Most companies indicated there was much less than an even chance that sourcing from North America would increase within one year. Thus, if current Japanese procurement patterns continue it is believed that Japanese HDTV production in the U.S. would increase electronic components imports into the U.S. This might in turn increase the U.S. trade deficit with Japan.

Finally, the developer of Japan's "Hi-Vision" HDTV system, NHK, has reportedly offered high definition technology to the Soviet Union. Japan reportedly differs with America on the COCOM treatment of HDTV technology exports. To the extent that America keeps HDTV research, development and production

in America, one can be more sure that America's interpretation of COCOM will be followed. Even in this day of perestroika and glasnost, it is easier to believe that the Soviets want high-definition technology for military purposes than that they plan to put a costly HDTV set in the living rooms of Soviet citizens who presently lack a black and white TV set, and at times even a living room.

In closing, I would urge this Committee to promote a level of U.S. government and industry cooperation worthy of both the potential of HDTV technology and the standard of living that Americans enjoy. America deserves more that a few dollars of tardy incentives against Japan's millions of dollars of current funding of HDTV commercialization. Americans deserve the opportunity to sell to and manage the companies marketing HDTV products in America. America should reject piecemeal support of HDTV commercialization and invest for substantial market share.

Senator GORE. Thank you very much. We will hold our questions until the final two members to the panel have completed their statements.

Ms. HUBBARD. Excuse me, if it is appropriate to continue with AEA, I would like to introduce my colleague.

Senator GORE. All right. Very good. But we are going to run out of time. We tried to limit the statements of each witnesses but you want to make a comment Mr. Stern?

Mr. STERN. Yes sir, I have some statistics on Japanese procurement of American components and the colored TV industry here, on Japanese hiring of Americans as Chief Executives in their industry here, on the level of funding that the Japanese government is currently undertaking with respect to high-definition television, and some video tape footage of some of the new technologies that are coming out of this effort. But it will take me a few minutes.

Senator GORE. How long?

Mr. STERN. About 11 minutes.

Senator GORE. We have a vote coming up on the floor, and I thought all the witnesses were advised that we wanted a 10-minute presentation. And so, I do not think we can devote all the time to one witness. I wish we could. If you could supply those figuresto us. Perhaps when we complete the panel we will have an opportunity to see your video tape. That is always interesting and enlightening, but really we are going to have tomove on—I apologize to you.

Ms. HUBBARD. Actually, it is my fault, but I think the video tape, if you have time, would certainly merit your attention.

Senator GORE. How long is the video tape?

Mr. STERN. The tape itself is approximately 10 seconds.

Senator GORE. I believe we could take time for that. We are going to use up 10 minutes trying to figure out what to do here. Why do we not go ahead with the rest of the panel and then play your video tape Mr. Stern. And I am sorry there was a misunderstanding but we do have time constraints.

Our next witness is Donald Johnstone, President and CEO of Philips Consumer Electronics, accompanied by Dr. Larry French. Please proceed, Mr. Johnstone.

STATEMENT OF DONALD JOHNSTONE, PRESIDENT AND CEO OF PHILIPS CONSUMER ELECTRONICS; ACCOMPANIED BY LARRY FRENCH, VICE PRESIDENT AND SENIOR TECHNICAL OFFICER, NORTH AMERICAN PHILIPS CORP.

Mr. JOHNSTONE. Mr. Chairman and members of the Committee, thank you for giving me the opportunity to appear before you this afternoon. As you mentioned my name is Don Johnstone and I am President and CEO of Philips Consumer Electronics Company which is headquartered in Knoxville, Tennessee, where we design, manufacture and market under the brands names of Magnavox, Sylvania, Philco and Philips. And in that capacity, we are probably the number two manufacturer and marketer of U.S. color television business. And I am accompanied on my right here by Dr. Larry French, who is Vice President and Senior Technical Officer of North American Philips Corporation, who incidentally is responsible for our U.S. HDTV efforts.

We are pleased to have the opportunity to discuss high definition television with you because we are devoting substantial resources to HDTV in Knoxville and in Briarcliff.

Our high-definition television system for North America has been developed at our research laboratories in Briarcliff Manor, New York, which employs 350 engineers and scientists. The work of our advanced development personnel in Knoxville, Tennessee, with another 300 engineers, is an integral part of our HDTV efforts and commitment. We are proud of our progress today and intend to continue our participation in both the HDTV standard-setting process and the debate on HDTV policy.

Legislators and other policy makers are rightfully asking themselves what is the role of government in HDTV. In our view, the most important action the government can take is to select a single mandatory standard for terrestrial broadcasting to ensure that timely and cost-effective introduction of HDTV. We have some very definite views about the basis on which the standard should be selected.

It must provide a high-definition viewing experience, not merely enhanced wide screen pictures. It should be compatible with today's NTSC picture standard. It should make efficient use of available spectrum. It should be suitable for all media, terrestrial broadcast cable,

satellite and recorded media, with the same quality level. It should provide for the improved rendition of color, multi-channel, compact disc quality sound, and widened aspect ratio. It should be implemented in a single-step transition to avoid unnecessary expense and confusion from broadcasters, receiver manufacturers and consumers.

As the committee must be aware, the FCC has established an advisory committee to consider HDTV issues. I am a member of that committee. We strongly support the advisory committee's progress and we urge the Congress to encourage and support that process, not to inhibit or duplicate the advisory committee's efforts.

The standard setting process should not be used to solve trade or competitive issues. Agencies and remedies exist. What is needed is use of what is available, not new creations. The government can and should adopt policies to foster general competitiveness by implementing a structured but real deficit-reduction program, a shift in available funding for worker education and training, changes in tax laws to stimulate savings and investment, removal of antitrust barriers to joint research and product development, and use of trade laws to promote free and fair competition in domestic and international market. Competitiveness is a broad issue and focusing solely on HDTV will leave those fundamental problems unresolved.

We likewise urge the government to exercise prudence with respect to the funding of HDTV research. To be sure, there are aspects of HDTV that could benefit from federal assistance, but for the most part, we hope that the government efforts will be directed toward creating the environment and infrastructure necessary for private enterprise to develop, manufacture and market HDTV products.

The U.S. should recognize that there is a strong U.S. industrial base in color television. Over 45 percent of the color television sets and approximately 60 percent of large-screen TVs are built in the United States, primarily by the man on my left, Zenith, ourselves and RCA. And they should build on this foundation, not duplicate it. Too expansive a government role, particularly one in which the use of government funds creates an interest in the success or failure of particular technologies may preclude objective assessments on issues as to which consumer welfare should be the guiding light.

We encourage the federal government to establish policies and provide incentive for cooperation that will permit private industry to do what it does best—develop, manufacture and market products and services. U.S. competitiveness in two HDTV-related technologies could be enhanced as a result of your efforts to incentivise business cooperation—integrated circuits and displays, as have already been mentioned here by previous speakers.

Digital processing and video processing and memory integrated circuits are currently used in television receivers and will, of course, be used in HDTV. Although the projections for the IC market are overstated, the technologies are important enough that the government should encourage cooperative efforts among U.S.-based computer companies who design and manufacture ICs, IC manufacturers and televi-

sion receiver manufacturers. The current DARPA effort are a good example of an appropriate government response.

Similarly, the government should encourage cooperative efforts between U.S.-based companies on large-screen displays, and in particular, projection television displays.

Again, the DARPA program is illustrative. NAPC also hopes that policymakers will do their best to let reason, rather than emotion, govern their assessment of the international trade issues associated with HDTV. All our HDTV effort is U.S.-based. And we have been and will continue to work with U.S. companies on HDTV. We not only design and manufacture our color television products here; we even export them to Canada and Taiwan, and in 1990, to Japan. Under these circumstances, denying our participation solely on the basis of ownership would be unfair and would overlook the vast amount of U.S.-based expertise, experience and resources that NAPC brings to the U.S. consumer electronics industry.

In the event some appropriate government response to U.S. competitive problems has developed, we believe that the following are the criteria for participation by U.S.-based companies. Surprisingly enough, they are not very far away from what the first speaker mentioned.

One, a U.S.-based long-term research product design and development.

Two, a complete U.S.-based manufacturing capability, including U.S. manufacturing of major components and subassemblies.

Three, a continuing long-term investment in U.S. facilities and employment.

Four, a commitment to sourcing of components with competitive U.S. suppliers and efforts to develop U.S. supplier infrastructure.

We agree with the American Electronics Association call for measures to boost U.S. competitiveness in world markets. We also agree on many of the issues and policy recommendations, and appreciate their recognition of the importance of U.S.-based companies with domestic R&D and manufacturing capabilities. However, we do disagree with two of AEA's-specific HDTV proposals, which we think will prove far too expensive and may delay, rather than expedite, U.S. progress on HDTV.

Specifically, we disagree with the formation of an ATV corporation. Many of the functions proposed for the ATV corporation are already or can be performed by existing federal agencies. We seriously question the need for an entire new government superstructure. The government should not be directly involved in end-product related areas.

We also disagree with the funding and involvement of other government agencies in the standard-setting process. The present process involving the FCC and the FCC Advisory Committee is working well.

Mr. Chairman, I think the central theme of my remarks is that you should exercise extreme caution as you proceed; caution that the so-called facts about HDTV are facts and not just assumption; caution in the use of taxpayer funds to promote a single technology; caution before reconstructing the entire regulatory process in HDTV standard setting; and caution that you not exclude those that bring something to

the table in crafting solutions that are best for our Nation's economic strength, industrial base, and most important, best for the American people.

Thank you again for your interest, and we will pleased to answer your questions. And we made it in nine minutes.

[The statement follows:]

STATEMENT OF NORTH AMERICAN PHILIPS CORPORATION

Mr. Chairman and members of the Committee, my name is Donald F. Johnstone. I am President and Chief Executive Officer of Philips Consumer Electronics Company, headquartered in Knoxville, Tennessee and a division of North American Philips Corporation (NAPC). I am accompanied by Dr. Larry J. French, Vice President and Senior Technical Officer of North American Philips. Mr. Chairman, today you have called a very important hearing to address the role of government in high definition television. You are to be commended for your leadership in this area, and for directing attention to emerging technologies that will impact this country's competitive position in the increasingly global marketplace. We appreciate having this opportunity to present our views.

HDTV has become a symbol of the importance of technological development to U.S. competitiveness. Many see developments in the TV business as our nation's "once in a lifetime opportunity" to seize dominance in nearly every technology. To some HDTV is a mere improvement in the television picture. NAPC believes that the truth, as usual, lies somewhere in between.

As your invitation to testify requested, I would like to address the issue of standards-setting in HDTV, U.S. competitiveness and the role of the U.S. government in fostering technology, particularly HDTV. But first, I would like to take just a moment to describe my company and its proposed system for high definition television.

North American Philips Corporation (NAPC) is the wholly-owned U.S. subsidiary of Philips Industries of the Netherlands, one of the world's largest electronics companies. NAPC has substantial presence dating back to 1933 in the United States, as shown by the brochure attached as part of our statement. Its U.S. dollar sales exceeded $5.4 billion in 1988, ranking it in the top 100 U.S. manufacturers. NAPC's twenty (20) operating divisions have 52,000 employees located in 96 facilities in 31 states. NAPC has 48 manufacturing locations, and research facilities in Briarcliff Manor, New York for general research, in Knoxville, Tennessee for television research and development, and in Sunnyvale, California for semiconductor research.

NAPC has over $3.0 billion in total assets in the United States, and intends to spend $1.5 billion in capital investment over the next five years. Its total capital investment in the United States exceeds $2.1 billion.

NAPC's operating divisions do substantial export business, exceeding $500 million. As only one example related to HDTV, Philips Consumer Electronics exports television receivers -- including projection televisions -- to Mexico, Canada, and Taiwan.

NAPC believes that its status brings a necessary perspective to the debate about information and policies for the United States in HDTV. The management of NAPC and its operating divisions and the management of Philips Industries are deeply committed to the U.S. market. Over the last 15 years, the U.S. market has increased from 3% to 15% of total sales of Philips Industries, and U.S. consumer electronics sales are now at least 25% of worldwide sales of Philips Industries. NAPC has three divisions involved in HDTV. Philips Consumer Electronics Company, manufactures and markets television receivers and other consumer electronic products under the Magnavox, Philco, Sylvania, and Philips brands. Philips Display Components Company, manufactures color picture tubes in Ottawa, Ohio, for Philips Consumer Electronics and third-party customers. Signetics Company manufactures semiconductors in Sunnyvale, California, Orem, Utah, and Albuquerque, New Mexico. NAPC has continued to make substantial investments in these and other U.S. operations. For example, over the last three years, NAPC has made capital investments of over $70 million in Philips

Consumer Electronics, $50 million in Philips Display Components, and $230 million in Signetics.

NAPC has been involved in High Definition Television (HDTV) research and development since 1984. The NAPC system -- High Definition System for North America (HDS-NA) -- was conceived, designed and developed in our research facilities in Briarcliff Manor, New York. HDS-NA was developed in the United States to meet the specific requirements of the United States television market. It embodies a single HDTV system standard usable on an even-handed basis by terrestrial broadcast, cable, and satellite. It is a uniquely American system.

HDS-NA is described in detail in an attachment to my statement. I would like to request that attachments to the statement be included in the record for this hearing.

The Role of the Federal Government - Standards

Mr. Chairman, you have asked what decisions this country must make about HDTV, and what role the federal government has in HDTV. There is one role about which there should be no debate: setting a mandatory HDTV standard for terrestrial broadcast. I am a member of the FCC Advisory

Committee on ATV. NAPC has participated in every stage of development in the HDTV standards-setting process.

Broadcasters provide the benefits of localism and diversity of free, over-the-air television broadcasting, and broadcasters are essential in bringing about an early adoption of HDTV.

The Federal Communications Commission and its Advisory Committee on Advanced Television Service are proceeding diligently to the testing and analysis of proponent systems, an effort requiring much time and money from private and public members of working groups. That effort should be encouraged to achieve as rapid a progress as possible, and funding necessary for the FCC's ongoing efforts should be provided.

NAPC has definite views on the characteristics of that standard, which we have consistently and forcefully presented to the relevant government agencies. In general, NAPC believes that an American HDTV standard should meet the needs of American consumers and should provide a full HDTV viewing experience. A mandatory standard is needed for terrestrial broadcasters; a marketplace decision would only prevent the timely and cost-effective implementation of HDTV. The chosen standard should provide HDTV quality

viewing through an efficient use of available radio-frequency spectrum. It should be backward compatible with NTSC, so that owners of present and future NTSC receivers will receive the same programming as owners of HDTV receivers. The chosen HDTV format should be suitable for use by all media -- terrestrial broadcast, cable, satellite, and recorded media -- with the same quality level. It should be implemented in a single step transition to HDTV, to avoid duplication of expense and confusion among broadcasters, equipment manufacturers, and consumers.

The performance characteristics of the chosen HDTV format should be:

1. High definition resolution
2. Elimination of perceptible artifacts
3. Multichannel compact disc quality sound
4. Improved color rendition
5. 16:9 aspect ratio
6. Pan and scan capability

Some believe that the standard setting process should be delayed, so that a new effort under the National Institute of Standards and Technology can develop an "American" standard. NAPC believes that such a delay would be contrary to American interests for several reasons. A number of American-developed standards have been proposed to

the FCC, including that from our Briarcliff, New York laboratories, which meets all of the performance characteristics Standards have been proposed by U.S.-based proponents for all of the methods of transmitting advanced television: the NAPC HDTV system, HDS-NA; the Sarnoff enhanced television system, ACTV-1; the Faroudja enhanced NTSC system; and the Zenith spectrum compatible simulcast system -- to name four of the nineteen contenders. The Systems Subcommittee of the FCC Advisory Committee may even propose some combination of the proposed systems, rather than recommend any one of the contenders. Second, because terrestrial broadcasting is regulated, it requires a change in standards to be able to introduce HDTV; other media such as cable, satellite, and recorded media do not require regulatory action. Delay in standard setting prevents broadcasters from introducing HDTV, potentially weakening their competitive position vis-a-vis competing media of cable and satellite. Thirdly, the lack of a standard opens the door for the introduction of equipment which would result in a de facto standard via recorded media. And that standard would certainly not be American based. Fourthly, NAPC sees no need to duplicate, through another government agency, industry-government cooperative efforts currently underway at the FCC. Finally, we wish to stress that any action that delays the standards-setting process is disadvantageous to U.S. involvement in HDTV. One HDTV

standard set in a timely manner will allow the private sector to invest in product development activities without the concern of false starts often incurred as a result of the lack of standards.

Standards are not the way to gain or enhance U.S. competitiveness. Competitiveness issues exist, both in U.S. industry generally, and in HDTV, and there are ways to address both of those matters, as we will explain. Trade issues also exist. NAPC and its predecessors, Magnavox and Sylvania have been involved in consumer electronics trade matters since the early 1970's, both in governmental and commercial arenas. Statutes, regulations, and responsible agencies exist to handle trade matters. The need is not for new laws or new agencies, either to process or monitor the trade practices of our foreign competitors. The mechanisms exist, and those who are interested can and should use them. What is needed is what we see developing in the administration and agencies: the interest in the need for free and fair competition at home and abroad, and the will to insure that those conditions exist. A new superstructure is not needed; making the present system operational is.

Some believe that the choice of an HDTV standard will create a strong patent position for the owner of the chosen system. Our investigation indicates that no such situation

will come about. It does not appear that any system proponent would enjoy market dominance by virtue of its patent position such as in the case of color television. The probable outcome is that, whichever system is chosen, patents from a number of patent holders will apply to that system. Therefore, NAPC questions the necessity of the debate over probable patent royalties.

Finally, it does not appear that standards will have a substantial effect on the location of HDTV manufacturing facilities. HDTV receivers will be built in the United States because of economic and commercial factors. Large screen sets are being built here now, and HDTV is a large screen product. NAPC sees no reason to build such sets offshore, and plans to manufacture its HDTV receivers in its Greeneville, Tennessee plant.

Some of those involved in the HDTV process have recommended the use of an Open Architecture Receiver ("OAR") as a solution to many of the technical and commercial difficulties encountered in the entry and implementation of HDTV. OAR is said to eliminate problems caused by the use of different standards for any particular medium, and to permit the development of incompatible standards among different media. Manufacturers respond, as do we, that such receivers will be far too costly to design and manufacture

and subsequently, too expensive for consumers, resulting in delayed acceptance and implementation of HDTV.

There is one idea on which almost all of those in this debate can agree: OAR should not be a substitute for a mandatory terrestrial broadcast standard, or a reason for failure to promulgate such a standard. As we will develop later, a mandatory broadcast standard is necessary for broadcasters to compete on an equal basis with other media, and to provide cost-effective products to the consumer.

Once such a standard is promulgated, a standard which is friendly to all media and permits each of them to provide an HDTV viewing experience of equal quality to the consumer, OAR becomes less of an issue. The EIA ATV committee has formed a special subcommittee to define a multiport HDTV receiver for interfaces ranging from terrestrial broadcast to fiber optic digital delivery. The friendliness of a standard to all media is an idea on which NAPC, AEA and EIA, among others, agree. In fact, whether or not to market OAR receivers becomes a choice which equipment manufacturers can make on the basis of market demand, technological cost and complexity, and consumer desires.

NAPC concurs with recent developments at the Advanced Television Systems Committee, the National

Telecommunications and Information Agency, the State Department, and the American National Standards Institute which will result in continued work on a production standard which will permit worldwide market access for program producers and which will be compatible with U.S. transmission standards. Increasing understanding of the relationship between transmission and production standards dictates that the U.S. pursue the adoption of an appropriate transmission standard before committing to any production standard.

The Role of the Federal Government - Competitiveness

It is a fact that many U.S. industries exhibit a lack of competitiveness, both in domestic and foreign markets. There are competitiveness aspects to HDTV, and the future of HDTV in this country is part of the overall concern over U.S. competitiveness. Therefore, it is important to define the arenas in which to examine competitiveness, the current status of those arenas, the needs for the restoration of competitiveness, and the policies required to improve competitiveness.

With respect to overall U.S. industrial competitiveness, NAPC participated in and supports the conclusions proposed by the Electronic Industries

Association in its report to the House Subcommittee on Telecommunications and Finance Subcommittee: "Consumer Electronics, HDTV and the Competitiveness of the U.S. Economy," in addition to NAPC's own recommendations to the Subcommittee. Those recommendations include:

1. A structured but real deficit reduction program to lower the cost of capital by decreasing the use of the nation's credit facilities by the federal government and freeing credit for industry.
2. A shift in available federal spending to those areas which will improve the human & technological infrastructure: education and worker training, development of the industrial infrastructure, and commercial science and technology. Education in mathematics and sciences is needed to compete in the world of technology, with sufficiently broad-based curricula to ensure the development of leadership. NAPC feels that those expenditures will have a more positive long-term effect than industry-specific expenditures which should be made by the industries concerned.
3. Changes in the tax laws to encourage investment and savings: (i) return of the investment tax credit and the graduated capital gains tax; (ii) a permanent

research and development tax credit; (iii) removal of disincentives to private saving.

4. Amendment of the antitrust laws to promote joint research and development activities closer to product development. Although consideration may be given to joint production, administrative difficulties appear to make such a policy uninviting. Certainly joint ventures in marketing should not be permitted, because they are almost certain to result in anticompetitive conduct.

5. Use of U.S. trade laws and international negotiation to promote greater openness in international markets and free and fair competition in the U.S. market.

An anti-business attitude must change to one which promotes the continuation and expansion of America's industrial base. Jobs, taxes, and technology will be promoted by creating an environment that fosters investment and effort by companies -- with domestic or foreign ownership -- with a commitment to the United States.

As we have noted earlier, there is a strong U.S.-based presence and participation in HDTV. There is also a strong U.S. industrial base in consumer electronics: NAPC, Thomson and Zenith, all with U.S. manufacturing, research and development, account for over 45% of the U.S. color

television market. Therefore, policies and actions to improve American competitiveness must build on what currently exists, not duplicate it.

The Role of HDTV in Consumer Electronics Competitiveness

NAPC's primary interest and involvement in HDTV is in the consumer electronics area and our comments are so focused.

There are a number of HDTV receiver market forecasts and most are based on the assumption that the FCC, with the guidance of its Advisory Committee, will select a standard in 1991 or 1992. The availability of hardware and programming will permit HDTV receiver sales about two years later. The most recent forecast by AEA projects is that one million HDTV sets will be sold in the year 2000. This forecast does not indicate what part will be a replacement for either the large screen segment or upgrades from the smaller screen segments or which would be incremental sales.

The HDTV receiver market, at least at the outset, will be a large screen (>30") market in both projection and direct view and, in large part, will replace the large screen products sold today. In 1988 there were 21 million television receivers sold in the U.S. with approximately

460,000 of these in the large screen segment. There are three basic factors in the growth of the HDTV receiver market: 1) some expansion of the total receiver market by increased sales in HDTV; 2) replacement of the present large screen market by HDTV; 3) replacement of some part of the (<30") market by HDTV.

To calculate the true volume growth in HDTV receivers is a complex undertaking. Some of the market will be expansion, but a large part will be displacement. Also, AEA's proposed sales level of 1 million HDTV receivers per year represents a penetration rate greater than that for color TV, and hence could be overly optimistic.

Much has also been written on HDTV being "revolutionary" in terms of associated technologies and products. In the area of television receivers we expect the impact of HDTV to be evolutionary in nature. Digital processing techniques are routinely utilized in present day products; they will be used in the future as costs are reduced, permitting either reduced receiver cost and/or increased features or performance. High speed video memories and video display processors are utilized in our current improved definition television (IDTV) products. Dramatic improvements continue in our projection television, which improve contrast, viewing angle, brightness, and resolution.

These improvements are major ingredients for HDTV and the improvements in today's products are some of the evolutionary steps required for HDTV. In contrast, revolutionary action is required to implement a new transmission standard that will encompass terrestrial broadcast, CATV, satellite, and recorded media.

HDTV and Other Industries

The two basic components of a television receiver are the display and the integrated circuits (ICs). HDTV requires more complex ICs and much better displays both of course at prices the consumer can afford. We recognize that developments in these two areas are relevant to other industries, such as the computer, telecommunications and medical industries. However, as television experts, we will focus on the effect of these developments on the HDTV receiver.

Integrated Circuits

High speed digital ICs, video processors, and video memories are presently used in TV receivers and will be used in HDTV. IC manufacturing processes for other applications such as high speed computer circuits could also be used for video memories and video display processors. There have

been numerous market forecasts for HDTV receiver ICs and most seem to be overly optimistic. For a first order quantification, consider the latest forecast (AEA) of 1M HDTV receivers sets ASP of $2K. Present industry estimates are that current TVs have approximately 5% IC content, and that the IC content of HDTV receivers is forecast to be 5-15%. This forecast gives a total U.S. available HDTV receiver IC market of $100-300M in the year 2000. Note that only part of this market is attributable to unique HDTV required ICs, and that it has not been discounted to reflect the loss in IC sales due to the replacement part of the HDTV market.

It is highly questionable whether the demand for ICs for HDTV receivers will be large enough to be a stand alone business opportunity. However, those who supply ICs for high speed memory and other related applications such as in the computer industry, could develop incremental sales of those ICs for HDTV television receivers and VCRs. Additional volume will drive down IC costs, permitting expansion in all end use product markets. The U.S. government should encourage co-operative effort among U.S.-based computer companies who design and manufacture ICs, IC manufacturers, and television receiver manufacturers. The current efforts of the Defense Advanced

Products Research Agency (DARPA) are a good example of how government can assist industry.

Displays

As previously stated, we expect the HDTV market (at least at the outset, and perhaps even by the year 2000) to be dominated by large screen (>30") receivers. Presently there is debate over the possible synergy in displays between consumer HDTV displays and other products such as computer work stations. The debate centers on the resolution and display size required for the TV receiver and other applications. Large displays clearly present the most enhanced viewing experience for the consumer, but might not be appropriate for applications such as work stations. Smaller display sizes could better serve applications such as work stations, but the viewing experience in the home is limited. Finally, there is the issue of resolution. For many applications, such as work stations and medical imaging, the resolution of present displays is higher than that projected to be delivered by HDTV.

One area in which there is general agreement is the need for large screen HDTV displays. The government should encourage co-operative efforts between U.S.-based companies on large screen displays and in particular projection

television receivers, along the lines of current DARPA efforts.

The Role of Federal Government - HDTV

Some participants in the HDTV debate urge the government -- Congress, the Administration, and independent agencies -- to assume a pro-active role in HDTV, by managing, funding, and promoting HDTV. Others suggest that the government has no role, that it should stay out as much as possible. NAPC believes that the government has several roles, but that its principal function should be to create the environment and infrastructure necessary for private enterprise to do what it does best: develop, manufacture and market products and services. Too expansive a role for government, particularly a role involving the use of public funds, creates the danger that the government will pick winners and losers, an activity best left to private industry and consumers. There is a temptation that government, once it has funded specific projects, will take steps to insure that its investment bears fruit. Tampering with the marketplace will not result in the best choice for consumers.

There is one area in which the government must take a role, the one we referred to earlier: promulgating a

mandatory HDTV standard for terrestrial broadcasting through the FCC process now underway. If that process needs encouragement or funding not available from private sources, serious consideration should be given to insuring the effectiveness and the timeliness of that process.

NAPC is not certain that government funding is necessary to insure American participation in HDTV. If it is determined that funding is necessary for public policy reasons (but not to improve the health of specific U.S. companies or industries) NAPC believes that the following characteristics should be considered when defining an American company for participation in U.S.-funded HDTV effort:

1. U.S. based long-term research, product design, and development.
2. Complete U.S. based manufacturing capability, including U.S. manufacture of major components and subassemblies.
3. Strong, fundamental commitment to a large U.S. presence over a long period of time, not opportunistically generated because of trade flows and restrictions.
4. Continuing long-term investment in U.S. facilities.

5. Healthy and growing U.S. employment.

6. Development of relevant technology in the U.S. which is adapted to U.S. needs.

7. Manufacture of products and exploitation of technology in the U.S.

8. U.S. management outlook and commitment of parent company to U.S. presence and investment.

9. Sourcing of components with competitive U.S. suppliers, and efforts to develop U.S. supplier infrastructure.

We have chosen these criteria not because they happen to fit our operations, but because we believe they are the proper criteria for evaluation, and the proper bases for full participation in the economy of any country. That is why we have adopted these principles to guide our U.S. presence, particularly in our HDTV efforts. What is important is not the ownership of the participant, but the commitment to the American economy, technology, and workers. Foreign-owned companies can be committed to investment in the United States; U.S. owned companies can make heavy investments offshore. NAPC, particularly PCEC, has chosen the former alternative. We have invested heavily in our U.S. facilities, and sustained losses while maintaining our American presence. We have paid our dues, and believe we

have a right to participate in HDTV on the same basis as anyone else with our commitment.

Implications of the AEA Proposal.

We also wish to respond to the Chairman's request for our comments on the implications of the AEA's report. We agree on many of the factual assumptions, issues, and policy recommendations of the AEA report, as we stated in filings with the FCC, NTIA, and the House Subcommittee on Telecommunications and Finance.

We agree that, in the technology and component infrastructure area, DSP and RAM design (e.g. video memories), and advanced high resolution large screen displays (in particular projection displays) are important to the U.S. We also agree that, in the system infrastructure area, electronic and electro-mechanical assembly, rapid product development, and material management (usually referred to overall as manufacturing systems) are also important to the U.S. Other equally or more important areas such as basic materials, automotive technologies, textiles, superconductivity, and biotechnology, are ignored. The focus on HDTV will not significantly alter the US competitiveness situation. Much greater focus is required

on the broader issues described earlier and on longer term R&D in generic technology areas.

We also agree that the availability of HDTV programming is a key issue, and most importantly that a single transmission standard is a necessity and must be established as rapidly as possible. We absolutely agree that the standard must be nothing less than HDTV, and that a direct move to HDTV is the best strategic course for the U.S. Evolutionary improvements to the receiver with very minor signal enhancements will provide excellent and continued enhancements to present small and large screen receivers. These steps are also ultimately required for HDTV.

We agree that some funding, such as the DARPA appropriation, should be made available for R&D activities in risky but promising HDTV areas. The private sector should identify the activities and should fund the majority (80-90%) of the R&D effort. In this manner industry has a strong motivation to achieve market success, and funding from government agencies such as DARPA are highly leveraged. The effort should have a commercial orientation and participation in the R&D programs should be based on the contributions to the U.S. technology/industrial base and economy. The two basic areas of IC's and large screen displays should be included. Consideration should be given

to R&D in generic technology having broad impact such as manufacturing systems.

NAPC supports clarification of antitrust rules for product based research and development. However, it has serious questions about relaxation of antitrust rules for production and marketing of products. Separation of matters of legitimate cooperation from the desire to engage in price fixing, market allocation, production restrictions and other antitrust offenses will be difficult and legally intensive exercises not warranted by the benefits to be gained. Consumers deserve competition; the proposed restrictions appear to inhibit competition and its recognized consumer benefits.

NAPC supports both bilateral and multilateral GATT negotiations to achieve fair and free trade in consumer electronic and advanced television, along with enforcement of U.S. trade laws to the same end.

We agree that the FCC and Congress should assure that broadcasters will be able to compete with other HDTV media in delivered viewing experience. The FCC should rapidly set HDTV standards that will allow broadcasters to deliver an equivalent viewing experience with other delivery media. Consideration could also be given for non-financial

incentives such as extended license terms for broadcasters who invest in HDTV. Direct financial investment could give unfair and unnecessary advantage to one part of the industry.

We disagree with three basic proposals as follows:

We disagree with the government management and funding role implicit in AEA's concept of the ATV Corporation. Many of the functions proposed for the ATV Corporation are already performed by existing federal agencies. The International Trade Administration has the authority and responsibility to monitor compliance with our dumping laws. The Department of Commerce has an Undersecretary for Technology to guide the development of HDTV technology, and to stimulate HDTV markets. NAPC seriously questions the need for an entire new government superstructure. The government should not be directly involved in end product related areas. The government should not be put in the position of picking "winning or losing" technologies or products; this is the private sector's role.

We do not believe that a new and duplicative effort to develop a standard through the National Institute of Standards and Technology is needed, nor that it will be any more effective in meeting this country's HDTV goals than the

current FCC efforts. The private sector with appropriate government regulatory bodies should set standards that are in the best interest of the U.S. consumer. The present process involving the FCC and the FCC Advisory Committee is working well. The FCC should be further supported to carry out the standards setting process. We see no reason or advantage to funding of other government agencies (such as NIST) for standards setting. Furthermore, any action that delays the standards setting process is disadvantageous to U.S. involvement in HDTV. One HDTV standard set in a timely manner will allow the private sector to invest in product development activities without the concern of false starts often incurred due to the lack of standards.

The suggestion that all patents applicable to HDTV be acquired by a government corporation for licensing, with the income to be devoted to U.S. investment in HDTV, has a surface appeal. On examination, NAPC believes that several questions cast doubt on the advisability of that program. First, the acquisition of patents, especially the determination of which patents are necessary, will involve expensive work and difficult decision-making. Second, the acquisition cost will certainly generate litigation, which might further delay the licensing and implementation of HDTV. The licensing criteria may also prove difficult to define and administer: the domestic content rules will have

to be flexible enough to maintain competitiveness in end use products and the changes in the component infrastructure. NAPC believes that the additional cost and attendant delay are not warranted by any benefit.

Mr. Chairman, I hope these views are of some assistance to you and your committee as you continue your deliberations. I think the central theme of our remarks is that you should exercise extreme caution as you proceed. Caution that the facts about HDTV are clear and convincing; caution in the use of taxpayer funds to promote a single technology, caution before reconstructing the entire regulatory process in HDTV standard setting, and caution that you not exclude those that bring something to the table in crafting solutions that are best for our nation's economic strengths, industrial base and, most important best for the American people.

Senator GORE. Thank you very much. We appreciate that.

Let me remind our audience that we do have another panel, so we are going to try to move on. Our last witness on this panel is Mr. William Connolly, President of Sony Advanced Systems.

Mr. Connolly, welcome.

STATEMENT OF WILLIAM CONNOLLY, PRESIDENT, SONY ADVANCED SYSTEMS

Mr. CONNOLLY. Thank you.

Mr. Chairman and members of the subcommittee, I am pleased to appear on behalf of Sony Corporation of America today. I have not had time to prepare a full statement, since I returned from a trip to Europe on Saturday.

I am President of Sony Advanced Systems of Teaneck, New Jersey, a division of the Sony Corporation of America. We are responsible for Sony's HDTV development in the United States. I have been in communications for 33 years, first, with Western Union; 23 years with CBS; and since 1983 with Sony. I hope to provide the perspective of both an engineer and a businessman. Two weeks ago I was pleased to receive the National Association of Broadcasters" Engineering Achievement Award for work that included, at CBS, an electronic still storage system that is widely used for election coverage.

Sony has over 14,000 employees in the United States and operates seven plants and three engineering facilities, with manufacturing assets of approximately $615 million and total U.S. assets of over $2.2 billion. We have manufacturing plants in Alabama, Pennsylvania, California, Florida, Indiana, and Texas.

Sony built its San Diego television plant in 1972. Then added a plant in 1974 that builds picture tubes from the ground up, some for export to several countries; not simply putting glass in boxes as has been suggested. Most recently we announced an advanced television research center in San Jose. This facility will start with 25 U.S. engineers and is expected to double operations in a short time. Through this center we hope to further develop HDTV in th United States, particularly with respect to motion pictures and post-production applications. We put it in Silicon Valley because that is where much of the talent and many of the suppliers are.

Today I would like to talk about U.S. opportunities and some potential problems. I would like to address three main points.

One, terrific things are happening now in HDTV in the United States. The U.S. television industry is poised to take advantage of new opportunities.

Point number two, there has been much talk about HDTV standards and competitiveness. A standard is a set of numbers that allows competing builders of equipment to work together. U.S. television and broadcast standards have worked best when they have been inclusionary, not exclusionary. I am concerned about recommendations that a U.S. HDTV standard should be deliberately exclusionary.

Three, there are significant measures government can take to spur U.S. research and development.

A television system can be divided into three major components: production, transmission and display. By production, I mean technology that captures and processes images for entertainment, medical, computer, and many other uses. Hollywood alone exports more than $3 billion a year. For several years companies based in Japan, Europe and the U.S. have been building equipment to the 1125/60 production standard. This standard was originally developed in Japan, but was thoroughly revised by the Society of Motion Picture and Television Engineers of the United States, and thus is also known as the SMPT 240-M standard.

At National Association of Broadcasters convention, Sony and 30 other companies demonstrated entire systems of equipment built by diverse companies, all hooked up and operating together. For example, Panavision of California, the foremost motion picture equipment provider worldwide, has worked together with Sony to create a new HDTV production camera compatible with the Panavision set of 2000 cinematographic lenses.

A small entrepreneur, Rebo of New York, began by producing HDTV programming, and expanded into research and development. Rebo recently announced two new products: a fiber optics driver and a frame storer. The latter in joint venture with Apple Computer. It is my

view that that the U.S. government should support such initiatives by collaborating in international fora on standards advantageous to the program producer in the United States and discouraging acceptance of parochialized standards that will unnecessarily splinter the economies of scale in world HDTV production.

Terrestrial broadcast transmission, as opposed to studio production standards, is a domestic regulatory issue and the province of the Federal Communications Commission. Sony stands ready to support any transmission selected by the FCC. We support the FCC's industry advisory process and we believe the FCC's two interim reports set forth neutral, fair and valuable principles.

Sony is also in the consumer and industrial television or display business. As I have said, most of the televisions and picture tubes we sell in the United States are made in San Diego.

For sound business reasons, Sony buys components locally whenever it can. For example, for many years we have used Motorola chips in our work stations, which we also manufacture in San Diego. In the past many U.S. component manufacturers have chosen not to manufacture products needed for many consumer devices. Today, however, there is an increasing interest in designing components for HDTV products. There is a myth that Japanese companies buy only from themselves or from other Japanese companies. I believe the overall record for Sony and others indicates that when high quality, reasonable-cost components are available from U.S. firms, they buy them.

Our doors are open for business and we are actively searching for U.S. manufacturing partners in a wide variety of HDTV applications.

How can the U.S. government promote HDTV? U.S. industry is accused of myopia, favoring short-term profits over long-term investment. This is too simplistic. What we need are circumstances of production that encourage, rather than discourage, investment.

I must tell you that nothing is more important in this respect than lowering the real cost of capital, mentioned here earlier on this panel.

Second, we must make it easier for U.S. universities to graduate more engineers and scientists and fewer LBO specialists.

I think also we should try to avoid to create a hothouse manufacturing industry in the United States. As I said at the outset, the purpose of a standard is to allow everyone to bring their best developments to the table. This allows constant, continuing improvement. By contrast, an exclusive hothouse industry invites only stagnation. The best example I can give you of a deliberately exclusionary hothouse television standard is Argentina's.

With respect to DARPA's solicitation and Sony's response, I want to quickly set the record straight. We propose to sell manufacturing technology to the United States for display and receivers. All prototypes will be manufactured here. This is not pork barrel. The U.S. government would own the right to use this technology. Frankly, as an architect of the proposal, I think it would be a great deal for the United States.

Thank you for inviting me to appear today. If I may leave you with one thought, based on 33 years in the industry, it is this. Above all, do not settle for technology capable of only limited applications and limited benefits. Utilize the work that has been accomplished to build upon it with American innovation.

Thank you very much.

Senator GORE. Thank you very much.

Mr. Stern, why do you not show us your videotape?

Mr. STERN. Thank you, Mr. Chairman.

The reason that Japan has made available about $900 million in public funds for high definition television development in Japan is that HDTV technology is not just television; it is a new generation of imaging technology.

In this video clip, which we will show in a second, you can see how HDTV technology is used to publish books and post cards, and to present a catalog shopper with a display showing how the jewelry that that shopper is viewing might be viewed from a variety of angles in the shopper's wardrobe, and in a variety of styles. In this case, HDTV is used as a publishing and a marketing tool.

Senator GORE. Was that it?

Mr. STERN. That was not it.

You may be interested to know that a number of Japanese companies have recently formed a for-profit corporation to promote high definition television technology in Japan.

[Pause.]

Mr. STERN. Well, if it will not come on immediately, I do not know what happens. We had it queued up, but thank you any way for the opportunity. And let us hope that the new generation of televisions is easier to use.

Senator GORE. Well, if your assistant wants to work with it while we are pursuing questions here. I am just goihg to ask a few questions and then yield to Senator Bryan.

Unfortunately we are not going to be able to spend quite as much time with the panel as I had wanted to.

Let me first deal with the question of who is us, as I began to do with Dr. Fields earlier.

Mr. Connolly, what is the U.S. content of the current Sony television set sold in the United States? What percentage of the components are made here, and in particular, what percentage of the electronic components are made here?

Mr. CONNOLLY. Well, the picture tubes, the cabinets, are made in our San Diego plant almost completely. It is very difficult to give a breakdown. I can find that out exactly and submit it for the electronics itself. But I know we do purchase some of the components locally at the San Diego plant.

Senator GORE. Okay. I would think that if it was a real high percentage, it would not be that difficult to get.

Mr. CONNOLLY. Well, as we have heard, there is only about 30 percent of the total cost that does contain electronics. The majority of it is the television tube, the cabinet, the flyback, the power supplies, and so forth.

Senator GORE. Any U.S.-made semiconductors chips?

Mr. CONNOLLY. To the best of my knowledge, yes. And as I mentioned earlier, in some of our other products manufactured in San Diego, we do use local chips, in the case of our work stations.

Senator GORE. Mr. Stern, do you want to comment on that?

Mr. STERN. A November 1987 survey of eight Japanese firms producing color televisions in North America, and this survey included Sony, but it also included other companies, showed that of a total of 18 key electronic components in a color television set, Japanese companies bought zero North American content for 14 components; and less than 30 percent North American content for three components. Cathode tubes were the only component sourced in North America by most companies.

North America includes Canada and Mexico.

Senator GORE. You mentioned the DARPA incident, Mr. Connolly. Has NHK, or any other group in Japan working on HDTV, ever invited an American company to apply to them for research funding?

Mr. CONNOLLY. I cannot speak to that. NHK, as you probably know, is modeled after the BBC, a quasi-public corporation, not government.

Senator GORE. Well, I said, or any other group in Japan working on HDTV. If you want to search for an answer to that and supply it to the Committee

Mr. CONNOLLY. But I would like to make one point. There was a mention earlier of the amount of money spent by the Japanese government for HDTV research and development. Sony is solely responsible for the funding ofall of its research and development in HDTV.

Senator GORE. Mr. Johnstone, back to the question of who is us. What is the U.S. content of your sets?

Mr. JOHNSTONE. Out of Greenville, Tennessee, approximately 75 percent or 80 percent. All our picture tubes are made in the United States; all our cabinets are built in Jefferson City; all our printed circuit boards; et cetera.

I think one of the better ways to look at it is: to build approximately 2 million television sets in that plant, we hire about 8,000 total employees in Tennessee. So that gives you a feel for the kind of vertical integration we have; which is another way to look at your content, through the employment.

Senator GORE. Mr. Pearlman, what is your U.S. content?

Mr. PEARLMAN. I would think that it is very similar to the content that North American-Philips has. When you are using a U.S. picture tube you have a large share of the content built right into the U.S. picture tube; and we make our own picture tubes.

But I believe that our U.S. semiconductor content is really miniscule. There are very few of the U.S. semiconductor producers who have shown an interest in wanting to build the low-priced chips that have gone into the existing generation of television.

When we introduced digital television sets in this marketplace six years ago, it was after working for about six years with ITT Germany to develop the chip set. And we could not get a second source in the U.S. semiconductor industry that wanted to try and develop digital chip sets for the television market.

Senator GORE. Your research on HDTV is here?

Mr. PEARLMAN. All of our white collar employment is here. All of our intellectual property development is in the U.S.

Senator GORE. Is that the same for you, Mr. Johnstone?

Mr. JOHNSTONE. Yes.

Senator GORE. Now, Philips in Europe has an entry in the EC sweepstakes. Is there a relationship between the standard they are pursuing and the standard that North American-Philips is pursuing?

Dr. FRENCH. No. The situation in Europe is very unique. And it is a different system. It is 1250/50, and there is basically no similarity between what is going on in Europe and the system that we are proposing for the United States.

Some of the components, of course, like tubes, as today, could well be common. But not in the standards in the basis technologies.

Mr. JOHNSTONE. Could I add just one thing there, Senator? Philips in Europe is right up to their eyeballs in fighting the same kind of competitive situation that we are in the United States. So they have very little resources to really help us here. And they have their own system and their own battle over there with the same kinds of problems that we face in the United States.

Senator GORE. So you really believe that you meet the standards that Dr. Fields laid out earlier in response to the question of who is us?

Mr. JOHNSTONE. There are no rules for being a good American player that we could not meet except the shareholders.

Senator GORE. Do you agree with that, Mr. Pearlman?

Mr. PEARLMAN. Senator, I believer North American-Philips meets the test that Dr. Fields laid out for receivers. I suspect that they would not meet the test for picture tubes, which are going to be 50 percent of the content, because they do have a more consolidated engineering operation led by Einthoven. But I think that they meet all the tests except for who owns the stock, which Dr. Fields listed as one of his criterion, and which I frankly do not believe ought to be a very important criterion.

Senator GORE. Now, you do not think Mr. Connolly's company is even close, do you?

Mr. PEARLMAN. I think there is very little intellectual property development going on in the television arena and picture tube arena in the San Diego facility.

Senator GORE. Mr. Connolly, are you us?

Mr. CONNOLLY. From our viewpoint, we are very much us. We are a manufacturing entity; we have about the same 8,000 employees in the consumer electronics manufacturing.

Senator GORE. Now, how many engineers did you commit to, 25?

Mr. CONNOLLY. That is only in our R&D center engaged in HDTV research in San Jose.

Senator GORE. What is the comparable number in Japan with the parent company?

Mr. CONNOLLY. What would I think the number of people? Perhaps 10 times that worldwide. There are 151 in Japan; we have—I might be a little bit wrong with the numbers—about 40 in Sony Broadcast Europe; and another research center in Australia. Their activities are all coordinated because our activities are global R&D with local application.

That is why we are concentrating on the HDTV for motion picture and television production.

Senator GORE. Were you itching to say something there?

All right. My time has expired on this round, and I apologize.

Senator Bryan, you are recognized.

Senator BRYAN. Thank you very much, Mr. Chairman.

Mr. Pearlman, the first question to you. You heard Dr. Fields comment earlier that his concern was not so much administration policy or congressional policy, but whether the industry itself could develop a coordinated response in terms of complementing efforts, and leading the charge.

What is your response?

Mr. PEARLMAN. I have spent a lot of personal time on this, Senator, for the last nine months or so, working with Secretary of Commerce Verity and the follow-on advisory committee to Secretary Mosbacher.

What we have found to date, what I have found is, as we have tried to encourage other major electronics players in the U.S. to become involved with this in any kind of committed fashion that would require money and time, that the response from the large corporations, the semiconductors corporations, the U.S. computer corporations, has been the profit environment in the consumer business is so terrible that unless someone will fix the environment, we would not think of making a capital investment in that kind of business. We are with you in our heads, we just are not with you in our pocketbook.

Senator BRYAN. So I take it that you feel that he makes a point in terms of the necessity to get American industry, more galvanized and to get it to engage in ia dialogue with the public sector in order to do something about this?

Mr. PEARLMAN. Yes. He also indicated that on his essential list was fix the environment for competitive pricing and the fair trade environment.

Senator BRYAN. I would agree with you there. We did not have a trade policy through most of the last administration. And much of the distortion in the marketplace, in my judgment, is a consequence of that failure.

Again, to you, Mr. Pearlman. As chairman of the ATV Corporation what do you think of the proposal that Ms. Hubbard advanced? Mr. Johnstone, I believe has indicated he does not agree with it.

Mr. PEARLMAN. I do not think it is terribly necessary. I think an advisory panel to Commerce and DARPA would provide the same function. If there is no money to administer, it does not matter what kind of corporation you have. And I think that is the key building block.

I think that there needs to be industry/government participation; I do not think it needs to be a corporation necessarily.

Senator BRYAN. But you do believe that there is a private/public sector partnership that can be forged here to help America, for lack of a better description?

Mr. PEARLMAN. Yes, sir, I do. And I have suggested that I think the industry ought to be willing to fund it themselves on an as-we-go basis, and that the Commerce Department ought to take the lead in specifying a licensing policy that would be very much a catalyst for promoting domestic content, particularly of semiconductors and displays.

Senator BRYAN. Mr. Connolly, an observation. You were trying, I thought, to make a point, that to counter the allegation that the Japanese buy only from themselves. You said that the Japanese want quality merchandise and that when the quality merchandise is American they wanted to buy American. Did I understand the essence of your testimony?

Mr. CONNOLLY. Yes. This was particularly directed to the question of U.S. manufacturing and local content.

Senator BRYAN. I appreciate that we are talking about two different industries, and please pardon my skepticism, but as we are meeting today in this subcommittee the full Senate is debating the FSX transfer. Here we have a world-class, top-of-the-line piece of military hardware, that is cheaper for the Japanese to buy, and yet they have said no.

I realize that you don't control Japanese government policy but I must say to you, with the greatest of respect, that some of us on this panel have some skepticism about the commitment of the Japanese government with respect to buying high quality technology if it is not Japanese.

Ms. Hubbard, a question to you if I may.

Senator GORE. Let me just say that if he wishes to respond——

Mr. CONNOLLY. I would like to respond. I think my remarks were those of the Sony Corporation of America and not those of the Japanese government policy.

On the basis of business, business to business, if we are offered a component at a reasonable price our doors would open. We will not spend more money for a component because it comes from somewhere else. We will procure that component locally if that is in the best business interest of the company.

Senator BRYAN. Thank you.

Ms. Hubbard, if Secretary Mosbacher said, look, you have got a couple of minutes, and that is probably about what I have got left on my time, and asked your advice, what should the government do? How can we help? Rank, in terms of priority, what would be the two or three things that you would urge him to do as part of government policy?

Ms. HUBBARD. I would fund DARPA. I would get the technology going.

Senator BRYAN. At what level, or do you have a number?

Ms. HUBBARD. I would do it the $100 million a year for three years. That should do it.

I would set up this management entity because, though I would long for the situation as Mr. Pearlman described, I think that there is a need for an industry-led management entity.

Again, the corporation concept is really probably inappropriate. It is really an advisory committee, if you will, but chartered to do certain things, and held accountable for those.

Secondly, I would set up these low-cost loans. And I would definitely begin a U.S. industry/government partnership. It is important that there is co-investment on the table. And I would look aggressively to the industry with policies that incentivise them for investment.

Senator BRYAN. You may have touched upon this in your testimony. If you did I will withdraw the question. But have you been invited to participate in a dialogue with the Secretary or his representative in terms of what government policy ought to consist of?

Ms. HUBBARD. We have not had that opportunity yet, however, we hope to do so imminently.

Senator BRYAN. And I would hope you would not be shy or reluctant to make your positions known as to what that policy ought to be, Ms. Hubbard.

Ms. HUBBARD. I have never been accused of being shy.

Senator BRYAN. Thank you so much.

And my time is up, Mr. Chairman. And I will yield back.

Senator GORE. Thank you, Senator.

Senator Kerry?

Senator KERRY. Thank you, Mr. Chairman.

Mr. Johnstone, I think you mentioned, as I came in earlier, the question of consorta and the potential for change in the antitrust laws. Is that a sine qua non of any effort here, or is that gravy, so to speak?

Mr. JOHNSTONE. Well, it is certainly not gravy. No, I think we believe that this is an area where industry, probably with some help in that area, could probably do a good job. And I think that is one of the things we really feel we are up against.

Senator KERRY. Well, is there more of an imperative to it? I mean, is it essential to getting us caught up? Here is an industry where $700 million plus has already been spent in another country where they have more engineers, and where they are more geared towards production and development, let alone research. And we are still at the research stage. Most people come to me say, look, we have got to be unfettered and given the capacity to go out and work together. That is not quite what I am hearing from you right now.

Mr. JOHNSTONE. Well, if you take HDTV in the narrow sense, and which often times you hear people discussing as though it is the television business that we are talking about, then I do not think we need anybody's help. I think we have enough of a base here. I think , in our

own case, we feel we have the technology, et cetera, to fare very well in making HDTV sets. We brought a system out of our own Briarcliff laboratories with about $15 million and about 30 engineers.

But if you take, as Senator Gore mentioned, HDTV in the very broadest of a mission, then I think I have to take off my hat as a leading consumer electronics company and then look at the welfare of the United States; then I join right in with the IC technology that we must not lose. And it is in that one area that I certainly think that the government should do everything possible, whatever it be, to not lose that. Because I see the chain effect of that as well.

But we do sometimes talk about it like it is a television industry, and at times it is not. And this is sometimes where we have problems with the AEA, because they say it is not a television business, but they talk to us like they want to get into manufacturing and marketing of the television business, which we feel we have a base of.

So I go back to the broader spectrum; we are in complete agreement there.

Senator KERRY. That is a good answer.

Mr. Pearlman, I wonder if you would address the controversy over whether we should pursue a single standard or an open network architecture model such as was discussed by MIT?

Mr. PEARLMAN. I think that will be market driven, and that to burden early sets in the market place with every possible ability to expand in the future for things that are yet to be identified would keep the industry from growing rapidly, and would therefore not provide the scale economies that are going to come as we get down the price curve very rapidly.

The television set of today has evolved in a very logical sort of fashion. If you say do we have an open architecture receiver now? When you look at all those plugs and jacks on the back of every television set, and the market finally demanded that you could plug a lot of different things in and make it do different things. The television set today could operate at multiple frequencies so that it could be used as a computer monitor. The market has not asked for that. It would add cost and it would make the set more expensive.

And I think that we are going to start with a pretty expensive product in the HDTV era and it should not be burdened, but it should be expected to evolve to add other functionality as the market demands it.

I think it is really a tempest in a pot of tea. And the market place is going to bring as much openness as people are willing to pay for. It is very easy to do technically.

Senator KERRY. But the open architecture approach will produce an HDTV that will cost more, will it not?

Mr. PEARLMAN. Oh, yes, a lot more, particularly if you have to define the set to be open for things that you cannot even imagine yet.

Dr. FRENCH. May I add one thing to that?

Senator KERRY. Yes.

Dr. FRENCH. Our concern is that open architecture could well be used as an excuse for not setting a standard. And if a standard is set, open architecture becomes a non-issue, because the industry will respond in the most economic way to address a consumer product. So open architecture is not an issue if the standards process that is presently underway is followed through with.

Senator KERRY. Mr. Connolly, do you want to also comment?

Mr. CONNOLLY. I would just add one other thing. I agree with everything that has been said about open architecture. The other point I would make is that I see nothing different about HDTV receivers as compared with the receiver of today. There is no reason why a multiport receiver, such as we have today, would not work for HDTV. If someone wants a satellite input, then they have a satellite converter; if they want a cable service, they can have a cable converter. The person who wants the service pays for it. But to burden every receiver with the cost of any of the potential input systems is, I think, a very costly approach.

Senator KERRY. Now, Mr. Pearlman, it is accurate, is it not, that the Zenith standard that has been proposed uses twice as much of the spectrum as the current NTSC broadcast standards?

Mr. PEARLMAN. We have proposed a simulcast system that would have one channel devoted to the HDTV section of the broadcast. But it does not use any more valid spectrum, because we have proposed a system that can be transmitted on all of the channels that are presently blacked out by FCC taboo regulations.

And, in fact, we propose a system where you could broadcast on every channel in the VHF band, for example, 2, 3, 4, 5, 6, in the same market. So 20 years from now, once everybody has bought their HDTV receiver, we could take the whole UHF band and give it back for other spectrum uses. And I believe we have got the only system that actually would provide more free spectrum at its mature stage.

Senator KERRY. Is that compatible with the current NTSC sets?

Mr. PEARLMAN. Any set that would be built to receive our HD picture could also receive NTSC. And a separate little black box could receive the signal and down-convert it and have NTSC come out the back. So, yes, it is doubly compatible.

Senator KERRY. And what impact would the frequency reallocation requirements have? Would they require existing stations to give up frequency and so forth?

Mr. PEARLMAN. No, we believe that there is enough frequency available in virtually every market, and we have not checked every one, so that every television station presently on the air could be given a second television station in the same market out of the existing bandwidth that is out there.

Senator KERRY. Ms. Hubbard, my staff has worked with you in trying to develop some proposals addressing support for engineering education. I know you are one of the experts on the whole question of person-power shortages in the field of engineering, et cetera.

Do we have enough engineers currently to be competitive in this field, or do we have to produce more, or be dependent on foreign engineers?

Ms. HUBBARD. I believe I heard someone say on the panel, in fact, I think it was Dr. Fields who said that for five years we would be okay. I think that is an optimistic view. I do not believe that with the continual erosion of U.S. presence at U.S. universities in television within the industry that we have developed a quantity of engineers who could get back into this business if it expanded substantially.

I have had discussions with industry people about this, university people, and I think we would have to ramp up, we would have to address the human resource issue.

Senator KERRY. We are going to run tight here, unfortunately, and my time is up.

Senator GORE. I want to ask a few more questions. We are going to try to finish the last panel before this vote, which is coming up around 5:00. As I look at this, and I want to say this by way of summary to this panel, there are several key issues—and if anybody violently disagrees with this summary, I want you to speak up.

First of all, is there a need for federal government action? I think the answer to that question is yes. That is the threshold issue, and I take it no one on this panel disagrees with that response. The second key issue is, if you decide there is a need for Federal Government action, whose purpose is to safeguard our ability to compete in HDTV-related industries then the question of who is "us," must be defined.

We had a dialogue about that. There will be disagreement on that question, but the criteria identifying a U.S. company listed by Dr. Fields earlier are a pretty good start. And I think you would agree with that, too, Mr. Johnstone.

Now, the third issue is, should we close the architecture soon or should we keep it open for a while? My answer to that is, when we close the architecture, we end a significant phase of the game. Before we do this we need to know what is the best outcome of that game for the United States. And I think we need to keep our eyes on that ball.

Next, how do we phase in whatever system we choose with terrestrial television and how do we deal with other transmission modes? Next, do we see global standards sooner or later? I think an answer to that question is emerging, but I will not belabor this point now. And then, finally what about changes in our antitrust law such as those Senator Kerry has proposed earlier this week.

We hope to pursue all of these questions. I hope that the Commerce Department will provide the leadership that the bill I introduced today seeks to require. And I hope that we all will have leadership from elsewhere in the administration on the educational issue that, Ms. Hubbard was discussing with Senator Kerry.

Senator GORE. Did you have anything more?

Senator KERRY. No, I will not belabor it because I know we are under time pressure here.

Senator GORE. Oh, all right, fine. Well, thank you very much and thank you all for participating. Let me call up the members of the second panel now. These are technology experts and television distribution groups.

Dr. Kenneth Flamm, a senior fellow at Brookings; Dr. John Abel, executive vice president of the National Association of Broadcasters; Dr. James Carnes, vice president for Consumer Electronics and Information Sciences at the David Sarnoff Research Center; Mr. Steve Effros, president of the Community Antenna Television Association, and Mr. Hal Berge, vice president for the Telecommunications Industry Association.

Gentlemen, we appreciate your presence on this panel. Without objection, your prepared statements will be included as a part of the record. I am going to ask, as a courtesy to the subcommittee and especially in light of the time constraints this upcoming vote imposes upon us, if you could compress your oral presentations. This would give enough time to all the panel members before we have to go over to vote on the FSX.

I might say, by way of preface to this panel, that, on the Commerce Committee, Senator Dan Inouye is the very able chairman of our Communications Subcommittee. As chairman of the Science, Technology, and Space Subcommittee, I have consulted closely with him. He is following the results of this hearing closely, and we intend to carefully respect the jurisdictional boundaries between the two subcommittees on HDTV. For example, the Communications Subcommittee has jurisdiction over the FCC action and related matters.

And we will soon, as a full committee, be facing those regulatory issues in a riper context. However, it is also necessary that we touch on aspects of regulation as we discuss the various science and technology issues. I wanted to just express my very keen awareness of that and let these witnesses know that Chairman Inouye and I along with other ;members of the Committee, including Senator Kerry, are working very closely together on this matter, along with other members of the committee.

Our first witnesses is Dr. Kenneth Flamm with the Brookings Institute. Dr. Flamm, thank you very much for being here and please proceed.

STATEMENT OF KENNETH FLAMM, SENIOR FELLOW, BROOKINGS INSTITUTION

Dr. FLAMM. Thank you very much, Mr. Chairman, for inviting me here today. I have to confess some perplexity, to some extent, in listening to the various threads of argument that have been spun out over the last several hours.

I would put it for the following reason. I am an economist by training. I have looked at the problems of high technology industries, particularly computers, semiconductors. And that is the perspective that I bring to these proceedings.

In general, I am sympathetic to the argument that we need a more commercial orientation—a substantial redirection in our policies which relate to investments in high technology, to make those investments more commercially relevant; we ought to be considering how we are going to build the industrial economy of the next century and how we are going to have an efficient, effective system in place.

The system we have in place right now is largely a leftover from a system in place at the end of World War II, when we were basically the only technological power on the globe. And I would argue that new realities—I do not have time to go through it all—but I would argue that new realities make it imperative that we reorganize and reconsider the way we are funding the commercially relevant technology base. So I am basically sympathetic to many of the themes that have emerged today.

However, having said that, I find myself in the position sometimes of the nagging mother-in-law, finding fault with some of the details in what has been presented. And I think, if one looks carefully at what has been talked about today, there are at least three different conceptions of what HDTV is all about.

First, there is the very narrow conception, the sort of analog, "pretty picture" system to match what the Japanese and Europeans are doing, to be put into place in the very near future, complete with factories chunking out TV sets in five or six years that are basically duplicates—or not duplicates, exactly, but U.S. versions—of basically the same technologies.

I would argue for a variety of reasons that that does not sound like a very effective expenditure of Federal resources. And I can go on on that subject a bit.

Secondly, we are talking about a program of research and development investments in information technologies in general. And, in my opinion, that sounds like a much better bet. These are longer-term sorts of investments in or information technologies that are clearly going to play a key role in productivity and our standard of living in the next century, and we certainly ought to get on with the task of putting into place that information-intensive economy.

And thirdly, we can see an even broader issue at stake here, and that is the whole system that we have in place for funding high technology and technology relevant to the commercial technology base. It is not just electronics; it is also aerospace and biotechnology and industrial chemicals and many other areas, and those certainly are things we ought to be thinking about as we enter the next century. So I think it is a somewhat broader issue.

Well, let's start at the first point, which is the very narrow issue: Is it worthwhile for the U.S. government to putting a lot of resources into chunking out TV sets, which basically match what the Europeans and Japanese are already well along the way towards producing, by, say 1995?

And you put it, I think, most vividly when you said that the real issue here, at the beginning of the hearing, was semiconductors. That what this really is about is semiconductors. Well, I would just point out that, if you look at the AEA proposal, for example, that it is really not particularly about semiconductors. It is about semiconductors, perhaps, as a market, but it is hard to see that the program of investment outlined there is really going to do a whole lot for the manufacturing technology side, other than through serving as a market for the semiconductor industry.

So the first and most obvious question, I would say, is, if the real issue is semiconductors, then why not do something for semiconductors rather than working indirectly through this so-called trickle-down effect from advanced television sets? That is something you certainly ought to be thinking about, if that, indeed, is the issue.

The second point is, that—here I am certainly not in the forecasting business—if you run the various numbers that have been floated about by, it strikes me as exceedingly unlikely that the scenario that you spun out—that most DRAMs or memory chips are going to be used in the high-definition television sets in the near future—is very likely.

And I would just pass some simple numbers by you. Last year, total worldwide shipments of computers were, perhaps, $120 billions with haldf shipped by the U.S. industry. The computer industry has been growing like bananas for, you know, 30 years; I think a conservative estimate of how large that industry by the year 2000 is going to be would perhaps be $200 billion or $300 billion, in that range.

Let's say that the average semiconductor content of a computer is 15 percent, and that is probably low at the moment. If you work it out, we are talking, what, $30 billion worth of semiconductor content in computers by the year 2000, conservatively. The BCG report—which may not be the best forecast around, but it is certainly the most expensive forecast, if Ms. Hill's figures are to be believed—suggest a market for HDTV equipment of all sorts, as I recall, in the neighborhood of $2 billion to $5 billion a year by the year 2000.

So, let's take Mr. Pearlman's estimated of a 25 percent semiconductor content. Multiply that by $2 billion to $5 billion and you are not coming anywhere near the semiconductor content of either the U.S.- or world-computer industry in the year 2000.

So, if it is in the cards for the HDTV industry to be roaring past the computer industry in semiconductor content, it is certainly not going to be by the year 2000, according to the numbers we have been hearing.I would alsolike to raise some doubts about the utility of these kinds of forecasting exercises in general. So—first point—let us entertain some reservations about HDTV as the optimal way to go about investing in semiconductors.

I have a lot of other points to make, but I see the little yellow light is on, so I am going to have to do it pretty speedily. I think the fundamental point is, where do we put our investments? And it seems to me that the content of both Dr. Fields' remarks, which I thought were well-put, and your initial remarks, for that matter, was that what we are really

talking about here, where the real pay-offs are going to be, is investing in information technology, the fundamental R&D base that underlies an exceedingly important sector of our economy.

In many of the industry proposals that we have heard, particularly the AEA proposal, I do not see that kind of broad-based funding program for information technology. I see a very narrow, very focused attempt to build factories in five years that are going to chunking out technology that is clearly going to be obsolete in the next century.

So my question for you is, should we not be thinking, instead of playing catch-up in an area where we do not have a great deal of strength at the moment, of forging ahead, leap-frogging into an area which clearly is going to be important. And that area is the integrated digital network of the next century with home, factory and office connected in a seamless system that shoots about large quantities of information and graphics, increasing productivity in our economy and improving our standard of living.

So I would say, let's talk about investing in all those technologies, getting that network infrastructure into place. And that, really, is the highest priority when we talk about investing in these technologies.

The second set of issues I would like to at least throw out for you, since I do not have time to explore them in any depth, is how do we go about investing in these technologies—not just information technology, but high technology in general, and what the government's program role is.

There are basically two sets of proposals that have been placed on the table. One has to do with funding research and development—some role in research and development consortia led by industry. The other set of proposals has to do with subsidies to capital. There is not much debate about subsidies to research and development.

There is widespread agreement within the economics profession that there is darn good argument for government involvement in funding research and development, particularly long-term, pre-competitive R&D. And it has to do with the fact that we expect social returns from those investments to greatly exceed private returns.

It is not at all clear that the same kind of argument can be applied to capital subsidies. Why is the HDTV industry more valuable or more deserving? Why is it more deserving of capital subsidies than the steel industry or the semiconductor industry or the computer industry or any list of industries? They all suffer from the same problems of the cost of capital, and it is not at all clear how there is some special social return coming out of these HDTV investments that merit special consideration compared to other industries. So I would urge you to think about that issue as well.

Finally, the whole question of antitrust relief, which comes up in a number of ways, particularly in the proposal that we have antitrust relief for production and manufacturing consortia. Here, it seems to me, we have a solution without a really pressing problem evident.

The bottom line, it seems to me, is that the reason this is such a popular proposal is that, on the face of it, it appears to involve no expenditures by the U.S. Government. It seems free. Of course, the cost, if there is one, is the cost to consumers, if proper safeguards are not built into such a proposal; it comes out of the consumers' pocketbook, not out of the U.S. Treasury, so the cost is hidden.

More importantly, there really has been an absence of a persuasive argument put forth as to why current antitrust regulations are a particularly formidable obstacle to the formation of joint ventures or consortia in high-technology industries. Joint ventures take place all the time in high-tech industries.

Furthermore, if you look at the country with the greatest experience with R&D consortia, Japan, there is only one halfway reasonable example of production consortia being formed to commercialize the outcome of R&D consortia that I am aware of. And that example, the attempt to forced mergers in the Japanese computer industry in the early 1970s, was a failure .

In general, the Japanese model is of a firm sending people to these R&D consortia. Those people serve as a vehicle for technology transfer when they return to their companies, and companies competitively develop products downstream from the pre-competitive R&D, in competition with one another.

My point is that the Japanese, who have had the greatest experience with this type of R&D consortia, have seen no need to form joint manufacturing consortia to successfully transfer this technology out of R&D and into production.

Finally, in conclusion, let me just say that I think the big issue here is what kind of structures do we have in place to deal with producing more relevant investments in the commercial technology base. You are going to see industry after industry and group after group coming to you with proposals for R&D consortia and other investments in high-tech areas.

There is a gentlemen here from Sarnoff; they have been pushing the idea of an optoelectronics consortia, investing in optoelectronics. Are we going to have go through dozens of hearings promoting the idea that optoelectronics is the greatest technology since sliced cheese, and it really is so much more deserving than anything else?

I would argue that it is, indeed, a deserving technology, but my point is that we ought to have some kind of structure, some kind of policy, some kind of organization in place that can deal with these problems, which are going to be increasingly important as we forge ahead with trying to revitalize our economy.

And, thus, I think it is important that we have a process and a structure and a policy, and I think HDTV is merely a small part of that much larger picture that I would urge you to consider.

Senator GORE. Well, very good. I'll come back to you with questions in response to that very provocative statement.

Let me just note that I agree with you on one aspect, and that is that the single highest priority for the United States of America, as it looks at the information age, is to establish a high-capacity data network of fiber optic cables. These cables would link advanced computing centers throughout the country with a capacity of between 3 and 10 billion bits of information transmitted each second. They would provide the opportunity for the equivalent of interchanges state and local and commercial spur lines, allow us to take advantage of the private networks that are already in place with a smooth interrelationship between public and private investment, leap-frogging what the Japanese and the Europeans are doing, and finally to take advantage of what has always been our thrump card, the largest, richest, unified market in the world and applying a new definition of infrastructure to that task.

Not just roads and bridges and highways and water and sewer lines, but high-capacity information superhighways. We will come back to that, because it is a little bit off the direct subject, but we are going to have other hearings on it. But I do think that is the single highest priority. I apologize for interrupting there. Dr. John Abel is with the NAB. Please proceed.

STATEMENT OF DR. JOHN ABEL, EXECUTIVE VICE PRESIDENT, NATIONAL ASSOCIATION OF BROADCASTERS

Dr. ABEL. Thank you, Mr. Chairman. As you know, the NAB represents radio and TV stations and the major commercial broadcast networks. At NAB, one of my responsibilities is to assess the impact of new technologies on broadcasters and to ensure that the broadcast industry can continue to deliver the highest quality service to the American public.

I would also like to acknowledge the assistance of Michael Rau, NAB vice president of science and technology, in the preparation of this testimony.

Let me begin by describing NAB's general view of advanced television. Broadcasting today provides the only free and universally available television service in the United States. For broadcasters, the challenge of HDTV is achieving a system-wide technical improvement for television broadcasting without disenfranchising the public's existing investment in TV receivers.

Our problems are spectrum and compatibility. Stations will need more band width to transmit HDTV pictures. But we are not asking for more spectrum than we now have allocated to us. At the same time, broadcasters do not wish to obsolete the 160 million TV sets in use, so we have a dual challenge. We want to broadcast HDTV pictures within spectrum limitations and we want to continue to provide a high level of television service with the current standard. We thank Congress for reminding the FCC of the importance that spectrum plays in ensuring that free, local broadcasters can achieve these goals.

The future of HDTV in this country can be divided into the transmission and manufacturing components. For broadcasters as the transmitters, the most important point is to establish a single HDTV broadcast transmission standard. Once the standard is set, the receiver manufacturers will know to what standard they should build their receivers. A single standard is absolutely required if consumers are to have access to advanced television receivers at the lowest possible price.

There are some painful lessons to be learned from broadcasters' experience with the lack of standard. With AM stereo, the FCC refused to set a standard, leaving it instead to the marketplace. As a result, we have massive confusion, confusion among broadcasters, receiver manufacturers, and consumers. We wish to avoid repeating this scenario with HDTV.

As broadcasters, we wonder about those who say that America is lagging behind in HDTV and about those who say that government and industry should work together. We are not behind and American broadcasters and government officials are well on their way to setting an HDTV transmission standard. We plan to do this without government subsidies, government loans or antitrust exemptions.

Permit me to briefly review what we have already done as we plan to bring HDTV to America. Over two years ago, NAB and MST conducted a transmission test of HDTV here in Washington. Following that test, broadcasters petitioned the FCC to establish a government-industry advisory panel to plan for the development and implementation of HDTV in this country.

HDTV transmission system proponents have shown their hardware at NAB-sponsored trade shows, and I should note that American companies are involved in the development of HDTV transmission systems. Contrary to conventional wisdom, not all HDTV players are foreign. The broadcast industry established the Advanced Television Test Center, on whose board I serve, to test the various transmission systems being developed. We think testing will begin in early 1990. We estimate that testing should take one year and that in 1991 we will submit a recommendation to the FCC for a single transmission standard for HDTV.

The FCC could select a standard in 1992 or 1993, and, by 1994, we estimate that broadcasters will be purchasing and installing HDTV transmission equipment. As soon as the FCC sets the standard, that will give the receiver manufacturers the necessary confidence to begin building receivers. So, you see, the broadcast industry has a plan.

Some, including consultants to DARPA, have suggested that the standard-setting process for broadcasting be delayed. In our view, a delay would be disastrous for consumers. For a country that is often seen as being behind in technology, it would be ironic if our own government were to hinder the broadcast industry's efforts to bring advanced television to the American public.

And it would also be ironic, since we plan to charge the viewers of our HDTV broadcasts the same price that we have charged for our service for the past 40 years—zero. Our service is free.

You have asked us to comment on open architecture receivers. We are opposed to these receivers for two reasons. First, open architecture receivers will raise the cost to consumers. Consumers will be presented with an expensive TV set and computer that will need additional hardware and software to display HDTV pictures. These receivers will burden consumers with technological complexity far beyond that which is needed or desired.

Secondly, open architecture receivers will permit the government and industry to avoid standards. Again, we note what happened with AM stereo when no standard was set by government. AM stereo receivers that can receive multiple standards have failed in the marketplace.

Those who favor open architecture receivers say that these receivers are needed to permit future improvements in the system. As you know, when television broadcasting began in this country, it was black and white with monaural sound. We have added color, stereo sound, teletext, captioning for the deaf, bilingual capability, telemetry and control signals, remote control, and now, picture in picture and color and clarity enhancements.

Despite these improvements, an owner of an early black and white TV set can continue to receive TV signals. So choosing an HDTV transmission standard does not preclude improvements to that standard in the future, and open architecture receiver telecomputers are not needed to ensure future improvements.

Finally, some have suggested that the future for HDTV in this country means it must be delivered to American homes over fiber optic networks. For example, a consultant to DARPA suggested that President Bush declare that, by the year 2000, all homes in America be wired for fiber and that the television broadcast spectrum be turned over to other industries, since television broadcasters will be out of business.

HDTV would be delivered to American households on this fiber network and American consumers will pay for the service. Believe me, they will pay. They will pay for the open architecture receiver, they will pay for the fiber connection, they will pay for the programming service, they will pay for each minute they watch, they will pay through their regular telephone service, since the telephone company will need to pay for this elaborate and expensive new network.

As an issue of public policy, America needs to ask whether we want a nation of HDTV "haves" and HDTV "have-nots." I repeat that the broadcast industry's plan for bringing HDTV to America is that the government will set a transmission standard and receiver manufacturers—ideally, American manufacturers—will build and sell economical receivers. It really is that simple.

So my story for you today is a good one. We are a uniquely American industry providing a free service to America. We have a plan and it is working. We are working with American and foreign industries and the American government to develop the next generation of television. Receiver manufacturers are involved in the process. We do not ask you for money, no billion-dollar subsidies, no loans, no grants. We

only ask that you help us to set a standard and preserve the existing broadcast spectrum. Thank you. I would be pleased to answer your questions.

[The statement follows:]

STATEMENT OF JOHN ABEL, EXECUTIVE VICE PRESIDENT, NATIONAL ASSOCIATION OF BROADCASTERS

Ladies and gentlemen, members of the Subcommittee, good morning. My name is John Abel. I am an Executive Vice President of the National Association of Broadcasters. As you know, the NAB represents the interests of radio and TV stations and the major commercial broadcast networks. Thank you for the opportunity to present NAB's views on the important issues of advanced television and U.S. competitiveness.

Let me begin by describing NAB's general view of advanced television. Broadcasting today provides the only free and universally available television service in the United States. There are more television sets in U.S. homes than telephones. The average household spends seven hours each day watching television. Obviously, HDTV presents some difficult issues for us all. But in some ways, the HDTV issue is more difficult for broadcasting than for other video distribution media. We need access to radio spectrum in order to deliver a competitive HDTV signal. At the same time, the industry does not wish to obsolete the nation's tremendous investment in today's television receivers.

In an attached Appendix are system descriptions of the major proponents for over-the-air delivery of advanced television.[1/] Basically, these systems fall into four broad categories. In the first category are single channel systems that are completely compatible with existing broadcasts and are based on the current NTSC television system. In the second category also are single channel systems, but these are not based on the current NTSC standard. Therefore, these second category systems must be simulcast in another part of the broadcast spectrum while NTSC broadcasts are

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1/ The Appendix was not reproducible.

maintained. In the final two categories are systems that require an augmentation channel to deliver HDTV quality into American homes. Either an additional half-channel or an additional full channel will be necessary. As you may have noted, three out of these four categories require additional spectrum for each station. Therefore, spectrum already allocated to television broadcasting must be preserved at least until a standard has been established for over-the-air HDTV. In this regard NAB appreciates the efforts of Congress, including the Chairman of this Subcommittee, in ensuring that the FCC recognizes that spectrum plays an important role in the continued vitality of free, local and universally available television service.

In formulating the panels before you today, you have been wise to distinguish the transmission side of the HDTV issue from the receiver manufacturing side. The policies for each may be different, as well as the respective needs for antitrust relief or government funding of research and development.

From the transmission side of the HDTV issue, I have good news. I am not here today to ask for money or additional government assistance. The broadcast industry is heavily involved in a process to develop a transmission system. We have a simple and straightforward plan to bring HDTV to American consumers at the lowest possible cost and as rapidly as possible. That plan is to establish a single broadcast transmission standard. Once this standard is selected, receiver manufacturers worldwide will have the confidence to invest resources in the mass production of HDTV receivers. We understand that some are concerned that foreign companies will build HDTV receivers

for the U.S. market, and that U.S. companies will not be competitive. This need not be the case.

The problem appears to be a broad question of U.S. trade policy and competitiveness. That is different from the process of selecting a single broadcast standard, which should remain unaffected. If the U.S. has a trade problem, let's propose a trade solution. If the U.S. needs more engineers to remain competitive, let's propose incentives to train and educate engineers and scientists. The existing advanced television standard-setting process should not be delayed in the hope of solving other and more complicated U.S. problems. To do so would delay the benefits of HDTV to the American consumer and permit foreign countries to establish HDTV service well before the U.S. NAB's plan would deliver HDTV at the earliest opportunity and, we believe, at the lowest cost and greatest benefit for the consumer.

Advanced Television is not a new issue for the television industry. We have been involved with blossoming of this issue throughout this decade. NAB attended the earliest meetings of the HDTV working groups of the Society of Motion Picture and Television engineers. Our annual engineering conference has featured technical papers on HDTV for years. It was NAB and MST that first broadcast HDTV here in Washington nearly two and one-half years ago. We are a charter and organizing member of the U.S. Advanced Television Systems Committee, formed in 1982. We supported establishment of the FCC's Advisory Committee on Advanced Television Services, a committee in which we actively participate. We have encouraged the

development of over-the-air HDTV systems, all with private sector financing. We have provided a forum for displaying these systems at our annual Convention. We will test these systems in the Advanced Television Test Center (ATTC). And by the end of 1991, we will recommend a single system for use by the television industry.

The television broadcast industry is in the earliest phases of selecting a single broadcast standard for free, over the air advanced television. A single standard is absolutely required if consumers are to have access to advanced television receivers at the lowest possible price. It is the existence of a standard, codified in the rules of the Federal Communications Commission, that gives receiver manufacturers the confidence to invest hundreds of millions of dollars in design and tooling for mass production of advanced television receivers. Manufacturers need to know, with certainty, that the receivers they sell will, in fact, receive advanced television service. Consumers need to know, with certainty, that what they buy will receive advanced television service. Only because we now have a standard is it possible for us to take for granted that a color television set purchased in Washington, D.C. will receive color television anywhere in the United States, as well as in many countries abroad.

As many are painfully aware, in 1982 the FCC declined to establish a standard for AM Stereo. As a result, less than 15% of AM stations today broadcast in stereo. Few jobs and a minimal new industry have been created around what could have been a promising new technological improvement to the public's reception of AM broadcasts. The message for HDTV standard-setting is clear. The U.S. needs a broadcast standard

to create jobs and breathe life into all the projections for a robust U.S. HDTV electronics economy.

Some have suggested that the standard-setting process for broadcasting be delayed under the mistaken impression that is the way to regain U.S. competitiveness. Such a strategy would deny U.S consumers the opportunity to enjoy HDTV, and may well provide foreign competitors with the additional time needed to prepare to penetrate the U.S. market. Delay at this stage will make the U.S. competitiveness situation much worse. For a country that is often viewed as being behind in technology development, it would be ironic if our own government were to hinder the broadcast industry's efforts to bring advanced television to the American public. Indeed, in just this past year, the broadcast industry has created, staffed, and funded the Advanced Television Test Center (ATTC) to objectively evaluate the technical options for delivery of advanced television. Such testing will include complex scientific measurements, subjective testing of consumer responses, and basic consumer research. The broadcast industry has done this for under $10 million and without government assistance. Two weeks ago we organized the world's largest exhibit of advanced television technologies at the NAB convention in Las Vegas. Very simply, we are well on the way to testing and evaluating competing advanced television systems.

You have asked us to comment on the concept of open architecture receivers. This is a deceptively simple phrase that sounds like it would solve everyone's HDTV problems. Unfortunately, it will not. Based on our conversations with receiver manufacturers, it

appears certain that an open architecture receiver will increase costs to consumers. The American public could be burdened with a requirement to purchase greater television complexity than is needed or desired. Some have argued that television technology and computer technology are destined to merge. But a television receiver is not a computer and is not likely to be used as one, at least for the vast majority of Americans. If some in America wish combination televisions and computers, we are confident that manufacturers, without government involvement, will supply them. Fostering the development of open architecture receivers is not the answer. An open architecture receiver also provides a reason for government to avoid selecting a single standard. A failure of decision-making in this regard will inevitably delay the introduction of HDTV to the American consumer.

Finally, there is no urgent requirement for receiver architectures that are substantially different than the receivers we have today. It has been argued that a flexible architecture is needed to accommodate technical improvements in the future. But history has shown that establishment of our current television standard has engendered a great many technical improvements. To the original black and white television standard we added color, stereo sound, teletext, captioning for the deaf, bilingual capability, telemetry and control signals, remote control and now "picture-in-picture," line doubling and comb filtering IDTV technologies. In a very similar way, choosing a specific HDTV standard will not preclude improvements to that standard in the future, all the while maintaining provision of low cost HDTV receivers for the public. If government and

industry can continue working together, by late 1991 we can recommend a single advanced television standard that will endure well into the next century.

There are many components to the standards decision process. Only a few HDTV system proponents have crossed the threshold that divides design theory from construction of actual operating hardware. And there are many important issues still to be decided. As I have stated, the industry's strategy is to provide the best quality system for the lowest consumer price. We will need to perform some consumer research to determine the nature of the cost/quality equation. Only then will the industry be prepared to use the additional spectrum already allocated to broadcasting that may be so necessary to providing increased quality. Another significant unknown is whether any of the many proposed advanced television technologies can sustain the higher receiver prices that generate all the rosy economic forecasts of the HDTV market. In the television industry's view, whatever standard is selected should be as economical as possible in order to maximize the chances for consumer acceptance.

Some have suggested that the future for HDTV in this country is that it must be delivered to American homes over fiber networks. For example, a consultant to DARPA suggested that President Bush declare that by the year 2000 all homes in America be wired for fiber and the television broadcast spectrum be turned over to other industries since television broadcasters will be out of business. HDTV would be delivered to American households on this fiber network and American consumers will pay for the service. Believe me they will pay. They will pay for the open architecture

receiver. They will pay for the fiber connection. They will pay for the programming service. They will pay for each minute they watch. They will pay through their regular telephone service, since the telephone company will need to pay for this elaborate and expensive new network. As an issue of public policy, America needs to ask whether we want a nation of HDTV "haves" and HDTV "have nots." I repeat that the broadcast industry's plan for bringing HDTV to America is that the government will set and we will implement a transmission standard and receiver manufacturers will build and sell economical receivers. It really is that simple.

Finally, permit me to address the issue of increased government/industry cooperation. For our industry, cooperation already exists with the government. At the request of Congress and the broadcasting industry, the FCC reserved television spectrum for advanced television and organized the advisory committee on advanced television services. We helped the House Telecommunications Subcommittee organize a demonstration of advanced television here on the Hill last September. We would be pleased to assist in organizing a Senate demonstration. Together with MST, we have not hesitated to keep government informed of technological developments. We have a plan and the plan is in process with an outcome expected in the early 1990s.

On the surface of it, the proposal of the American Electronics Association sounds appealing, but again at what cost? From our perspective, when the FCC sets a standard there will be nothing to prevent the members of AEA from entering the television receiver manufacturing business. What exactly holds them back? On the issue of

whether they need an anti-trust exemption or government subsidies to do this, I really don't know. I am not an anti-trust expert, but I do know that there will be billions of dollars to be made in the receiver manufacturing side of the business. AEA represents the biggest and the best -- surely they can find a way to compete.

So, my story for you today is a positive one. We are a uniquely American industry, providing a free service to America. We have a plan and it is working. We are working with American and foreign industries and the American government to develop the next generation of television. Receiver manufacturers are involved in the process. We do not ask you for money -- no subsidies, no loans, no grants. We only ask that you help us to set a standard and preserve the existing spectrum allocated for broadcast use.

Thank you. I would be pleased to answer your questions.

Senator KERRY. Thank you very much. I would ask the chairman if you would permit me just to ask a couple quick questions, because, unfortunately, I have to go to a meeting on Panama and General Noriega.

I would really like to stay and pursue this but I can't. So, my staff will stay here and I may submit questions. But, Mr. Abel, let me just ask you something.

About the single standard that you are advocating. It seemed to me that you talked about the principal of consumers having access to the high-definition television at the lowest possible price. Having listened to the prior panel and the whole concept of open architecture and the food chain. I wanted to akk if that is that really all we are talking about; consumers getting access to the pretty pictures Dr. Flamm talked about at the lowest possible price?

Is there not considerably more at stake here, in terms of what the open architecture might make available, the services that might be available and the technologies that will go along with that, and the various synergies of other disciplines that get drawn in, whether military or medical or teaching and so forth?

Dr. ABEL. Certainly there are other issues and it is bigger than just having consumers have HDTV receivers. And no question about it, an OAR receiver, an open architecture receiver would be capable of doing other things, a variety of other things. It would have, I think, great application in business. But at what cost are we going to charge consumers for this high-end product?

And are they going to purchase this high-end product, while, in the mean time, we are going to have an NTSC continuing service, and, as you heard the other panelists say, the broadcast industry, the television entertainment and information industry, if you will, including cable broadcasters and others, are going to drive the consumer market. We

are going to be the ones that are the reason why a consumer is going to buy that receiver. And if the receiver is very high in cost, they are not going to do that; they are going to buy an NTSC receiver, or, perhaps, a low-end HDTV receiver.

So I think it is, and I think you have been misled to some extent to think that these HDTV receivers have to be filled with expensive semiconductors. If we set a single standard, the receiver will be more inexpensive, less expensive, if you will, than an OAR receiver that would be filled with semiconductors.

Senator KERRY. Well, I do not want to abuse the indulgence of the chairman in letting me interrupt here. As I said, I have to go, but I really would like to pursue some of that with you and Dr. Flamm, you raised a number of provocative comments and assumptions which are very worth the committee's following up on, obviously, and I want to do that.

My apologies to the other panelists for my early departure. I thank you, Mr. Chairman, very much.

Senator GORE. I think that is quite appropriate. We appreciate those very good comments and questions. And I take it you have completed your statement, Dr. Abel.

Dr. Carnes, we have been following the recent publicity about the developments at the Sarnoff Center and we welcome you here to summarize your presentation.

STATEMENT OF DR. JAMES E. CARNES, VICE PRESIDENT, CONSUMER ELECTRONICS AND INFORMATION SCIENCES, DAVID SARNOFF RESEARCH CENTER

Dr. CARNES. Thank you, Mr. chairman. I appreciate the opportunity to appear here this afternoon. I am speaking on behalf of the David Sarnoff Research Center in Princeton, New Jersey, a subsidiary of SRI International of Menlo Park, California, an American company.

Before addressing specific items, I would like to point out that there are multiple technologies involved in HDTV. It is not a monolithic subject. First there is video production, equipment such as cameras and professional tape recorders, monitors and the production standards which specify that equipment. In this area, Japan seems clearly in the lead as a manufacturer and marketer. Europe is working hard with substantial government funding to catch up. It is in this area that the debate over a single worldwide production standard for HDTV is raging.

But there is yet another distinct technology area where the U.S. is in the lead over Japan and Europe. This is in the area of transmission of the advanced television pictures from the TV studio to the viewers" homes. In my view, this is single most critical area. Here, the U.S. is in the lead.

Let me tell you why I believe we are ahead. Both Japan and Europe have developed transmission systems which depend solely upon direct satellite-to-home delivery of advanced television signals. But total reliance on satellite-direct-to-home delivery is not consistent with the

television system and policy developed in the United States. Our system emphasizes local content, such as local news programming, which is not workable with DBS.

Free local television with local information content has been the bedrock of our broadcast and television policy, and the public has come to expect it. It is key to our way of life in America and our HDTV transmission system must reflect this fact. As an elected official, Senator, I am sure that you understand the value of local television delivered by broadcasters and cable operators.

So the first point I would like to make is this: in the most critical area of advanced television, that of transmission systems for broadcast and cable, the United States leads the world. And while Japan and Europe have few approaches for local broadcasters and cable operators, the U.S. has 15 proposals. To me, that does not sound like we are behind.

I would like to talk more about this singularly important transmission standard issue. The ideal transmission standard must meet the needs of the viewing public and the various elements of the television industry. Producers, broadcasters, cable operators, professional equipment suppliers, and consumer electronics manufacturers. Clearly, if HDTV is to be a flagship technology in the battle to regain U.S. competitiveness, we must select standards which make sense for the U.S. viewing public and the TV industry.

We must create a vibrant and rapidly growing HDTV business in the U.S. Only then can the system be economically marketable, enabling the beneficial side effects to accrue for the U.S. semiconductor, computer, telecommunications and general electronics businesses.

We must remember that the best standard is one which best meets the needs of the U.S. viewing public. The U.S. consumer has proven over and over again that they will not embrace a product unless it makes sense for them. They will not buy a product just because it happens to be good for the U.S. semiconductor industry or the computer industry or whatever industry. If this were the case, our consumer electronics industry would probably still be U.S.-owned and our auto industry would still have 100 percent of the market.

A very significant amount of work has been done in the U.S. in the area of transmission standard development. At Sarnoff, our sponsors, General Electric, NBC, ABC, the NBC affiliates and Thomson Consumer Electronics, have invested close to $70 million over the past six years to develop ACTV designed specifically for the unique needs of the U.S. market.

I would like to comment on the concept that some have proposed of doing nothing now, but rather waiting until the U.S. can make one large leap-frog step to full HDTV. I believe this is an unnecessarily risky approach.

In fact, today, the technology does not exist to send full HDTV-quality pictures over a single 6 Mh TV channel. Certainly, a vigorous program to develop such a capability, using digital signals, should be pursued as a national priority. But America cannot afford to do nothing

else for the five or 10 or even more years until this leap-frog capability arrives.

Unless Congress is prepared to legislate against improvements in television until we are ready for this leap-frog, we run the risk that non-broadcastable and confusing de facto standards will be introduced into the marketplace, such as imported, high-definition VCRs. This would confuse the consumer and throw a wet blanket on the U.S. advanced television marketplace.

Now, my comments that much, in fact, is going on in the U.S. in HDTV were not meant to suggest that the government has no role. Rather, you, Mr. Chairman, and leaders like you can play a significant role to encourage HDTV development and manufacturing which should have a beneficial effect on U.S. competitiveness.

Some areas where the government could help: provide mechanisms to lower the cost of capital for U.S. industry; encourage industry investment in R&D by increasing tax credits and making them permanent; encourage and aid the FCC transmission standard selection process by adequate funding, avoid interrupting or artificially influencing that activity; encourage enforcement of existing fair trade laws for the consumer electronics industry; ensure that the spectrum is reserved so that our unique American system of free, local broadcasting will remain viable; help prime HDTV R&D by appropriating funds for DARPA and/or NIST to administer; encourage cooperation in R&D by further relaxing antitrust restrictions on such activities. Thank you very much.

Senator GORE. Thank you very much. We certainly appreciate that.

[The statement follows:]

Testimony

of

Dr. James E. Carnes

David Sarnoff Research Center

before the

Subcommittee on Science, Technology and Space

May 16, 1989

Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to appear before you this afternoon to discuss the status of HDTV research and development in the United States and what steps can be taken by the Congress and the Administration to ensure U.S. technological leadership in this important field.

Mr. Chairman, you and the Subcommittee are to be commended for your leadership on this issue. It is important that we develop a national strategy for HDTV development in this country. But it is equally important that we do so with all the facts and with full recognition of the interests of the consumer and the existing U.S. television industry.

I am speaking on behalf of the David Sarnoff Research Center in Princeton, New Jersey, a subsidiary of SRI International of Menlo Park, California, an American Company. We formerly were RCA Laboratories, inventors of the NTSC color television system

currently in use in the United States, Japan and other countries comprising about one-half of the world's television viewers. In addition to the NTSC system, Sarnoff labs is also the inventors of many of the critical components and technologies responsible for today's television and semiconductor industries, including camera technology, color television picture tubes, addressable liquid crystal displays, and the CMOS technology used by the semiconductor industry around the world -- to name but a few.

At present we are working to develop an advanced television transmission system specifically to meet the unique needs of the American viewing public and television industry. Our system is Advanced Compatible Television (ACTV). It is a two-step, evolutionary approach for moving America into the advanced television era quickly and in a manner which will not leave us disadvantaged relative to other countries of the world. We are well along in the development of this transmission system which I will discuss in more detail later.

Before addressing specific items I would like to point out that there are multiple technologies involved in HDTV -- it is not a monolithic subject. First there is video production -- equipment such as cameras and professional tape recorders, monitors, and the production standards which specify that equipment. In this area Japan seems clearly in the lead as a manufacturer and marketer. Europe is working hard with

substantial government funding to catch up. It is in this area that the debate over a single worldwide production standard for HDTV is raging.

There is another very important technology area -- that of consumer displays. Full HDTV probably doesn't make sense unless the TV screens are large -- much larger than today's screens. Conventional picture tube technology will need to be succeeded by new ideas and technology for the larger screen sizes. Japan is working vigorously with government funding to develop liquid crystal display technology for this purpose. No one in the world presently appears to hold a clear-cut lead. The U.S. must get going quickly if we want to be a player in this very important business.

There is yet a third distinct technology area where the U.S. is in the lead over Japan and Europe. This is in the area of transmission of the advanced television pictures from the TV studio to the viewers' homes. In my view this is the single most critical area. Here the U.S. is ahead.

Both Japan and Europe have developed transmission systems which depend solely upon direct satellite to home delivery of advanced television signals. But total reliance on satellite direct to home delivery is not consistent with the television system and policy developed in the U.S. Our system emphasizes

local content, such as local news programming, which is not workable with DBS. Free local television with local information content has been the bedrock of our broadcast and television policy, and the public has come to expect it. It is key to our way of life in America and our HDTV transmission system must reflect this fact. As elected officials, I'm sure this subcommittee understands the value of local television delivered by broadcasters and cable operators.

So, the first point I would like to make is this: in the most critical area of advanced television -- that of transmission systems for broadcast and cable -- the United States leads the world. And while Japan and Europe have few approaches for local broadcasters and cable operators, the U.S. has fifteen proposals. To me that does not sound like we are behind!

I would like to talk more about this singularly important transmission standard issue. The ideal transmission standard must meet the needs of the viewing public and the various elements of the television industry: producers, broadcasters, cable operators, professional equipment suppliers, and consumer electronics manufacturers. Clearly, if HDTV is to be a flagship technology in the battle to regain U.S. competitiveness, we must select standards which make sense for the U.S. viewing public and the TV industry. We must create a vibrant and rapidly growing HDTV business in the U.S. Only then can the system be

economically marketable, enabling the beneficial side effects to accrue for the U.S. semiconductor, computer, telecommunications and general electronics businesses.

We must remember that the best standard is the one which best meets the needs of the U.S. viewing public. The U.S. consumer has proved over and over that they will not embrace a product unless it makes sense to them. They will not buy a product just because it happens to be good for the U.S. semiconductor industry or the computer industry or whatever industry. If this were the case our consumer electronics industry would probably still be U.S.-owned and our auto industry would still have 100% of the market.

A very significant amount of work has been done in the U.S. in the area of transmission system development. At Sarnoff, our sponsors -- General Electric, NBC, ABC, the NBC Affiliates and Thomson Consumer Electronics -- have invested close to 70 million dollars over the past six years to develop ACTV, designed specifically for the unique needs of the U.S. market.

ACTV is a two-step, evolutionary system. ACTV-I is a single channel, widescreen, enhanced definition system with twice as many scan lines as our present system and digital stereo audio. It is completely compatible with the 160 million TV receivers in use today. It can be implemented quickly and its performance

matches or surpasses the capabilities of available consumer display technology. In the future, when very large HDTV display screens reach consumer prices, ACTV-II service using a second TV channel would begin. ACTV-II delivers virtually full studio level HDTV performance to the home -- the only proposal we know of which does. In order to have the channel space available for ACTV-II when it is needed, it is critical that spectrum be preserved for that use.

ACTV has been terrestrially broadcast over the air during regular viewing hours. No one else in the world has done this. We have tested our system over cable and satellite. We have demonstrated that initial television studio cameras and equipment will cost only a fraction of other proposals. ACTV has been tested with actual broadcasts -- not just computer simulations. It has been demonstrated to be a viable system -- both technically and operationally.

The FCC has the responsibility for determining which transmission system is most workable for the broadcast industry. To do this, the FCC is implementing a thorough and substantial process to evaluate and test the various transmission proposals. This activity involves a high level of industry-funded participation in the Advisory Committee on Advanced Television Systems. Under the able leadership of Richard Wiley, hundreds of industry participants have invested thousands of hours of time

over the past two years. In addition the industry-funded Advanced Television Test Center will begin testing proponent systems earlier next year. As I noted earlier, the transmission standard must be based upon its ability to meet the needs of the viewer and the television industry. The testing and evaluation process underway is the best mechanism to do just that, and the FCC is the best agency to handle the process. However, the FCC should be adequately funded to ensure that it can meet the testing and evaluation timetable it has before it.

As I have described, a tremendous amount of work has been done and is now underway to develop and select a transmission system which makes sense for America. It is an area where we hold a substantial lead over the Japanese and the Europeans. We still have work to do, but the end is in sight. Now is not the time to throw up our hands and start over. Nor is such a step necessary for the competitive future of HDTV nor the semiconductor and electronics industry in the United States.

I would like to comment on the concept that some have proposed of waiting until the U.S. can make one large, leap-frog step to full HDTV. I believe this is an unnecessarily risky approach. In fact, today the technology does not exist to send full HDTV quality picture over a single 6 MHz TV channel. Certainly a vigorous program to develop such a capability should be pursued. But America cannot afford to do nothing for the five

or ten or even more years until this leap-frog capability arrives.

Unless Congress is prepared to legislate against improvements in television until we are ready for this leap-frog, we run the risk that non-broadcastable and confusing de facto standards will be introduced into the marketplace, such as imported high definition VCR's. This would confuse the consumer and throw a wet blanket on the U.S. advanced television marketplace.

Waiting for the leap-frog creates a market vacuum and we cannot permit an advanced television vacuum to exist. So we must act quickly. At the same time we cannot ask the American consumer to settle for less than the best quality. This "move fast-best quality" paradox is a difficult one. We designed the two steps of ACTV specifically to solve this dilemma.

My earlier comments that much in fact is going on in the U.S. in HDTV were not meant to suggest that the government has no role. Rather, you, Mr. Chairman, and leaders like you can play a significant role to encourage HDTV development and manufacturing which should have a beneficial effect on U.S. competitiveness. If our goal is to return the United States to a position of leadership in consumer electronics using HDTV as the vehicle, we must not look for quick fixes. We must bear in mind the

fundamental economic pressures and policies which caused American business to sell the consumer electronics industry to foreigners in the first place.

There is not time now for me to elaborate on this long history. Rather, let us concentrate on fixing the fundamental, underlying reasons why it is extremely difficult to be profitable as a consumer electronics company in the U.S.

Some areas where the government could help:

- Provide mechanisms to lower the cost of capital for U.S. industry.

- Encourage industry investment in R&D by increasing tax credits and making them permanent.

- Encourage and aid the FCC transmission standard selection process by adequate funding. Avoid interrupting or artificially influencing that activity.

- Encourage enforcement of existing fair trade laws for the consumer electronics industry.

- Ensure that spectrum is reserved so that our unique American system of free, local broadcasting will remain viable.

- Help prime HDTV R&D by appropriating funds for DARPA and NIST to administer.

- Encourage cooperation in R&D by further relaxing anti-trust restrictions on such activities.

In summary, I believe the United States leads the world in the most critical HDTV area -- transmission to the home. A tremendous amount of work is already behind us. We should not throw away what has been done so far, but rather we should nurture and encourage and build upon it. We cannot afford to do nothing but wait for a leapfrog solution. We must select a transmission standard which meets the unique needs of America.

Senator GORE. Thank you very much. Mr. Steve Effros, president of CATV Association, welcome. Please proceed.

STATEMENT OF STEVE EFFROS, PRESIDENT, COMMUNITY ANTENNA TELEVISION ASSOCIATION

Mr. EFFROS. Thank you, Senator. I will keep it very short. In terms of cable and HDTV, whatever HDTV ultimately gets to be, we will be transmitting it or distributing it and we agree 100 percent with you that, ultimately, there is going to be a fiber optic highway in this country. I think we are probably farther along than most people in putting it together and we hope to continue to do that.

But the problem in today's testimony, I suspect, is a little bit broader, and Dr. Flamm, I was very happy to hear his testimony because I always feel like I am spitting in the wind by myself when I challenge the advocates of HDTV.

He mentioned that he discerned three different HDTV's in the discussion today. I broke it down into four or five. One is "pretty pictures," as he said, television improvement. And I would split that down into either analog or digital improvement; they are two totally different concepts of HDTV. One is short-term, the other is long-term.

Senator GORE. We are moving toward digital, though, are we not?

Mr. EFFROS. Well, no, sir, I do not think that of the proposals before the FCC today, any of them are purely digital. All of them are analog and they are all proposed—am I wrong on that one? All right, I am wrong on that one.

Senator GORE. I mean, television is going digital, is it not?

Mr. EFFROS. Not in terms of the transmission.

Senator GORE. It is already going digital.

Mr. EFFROS. Not in terms of the currently proposed transmission. I do not think Mr. Abel would suspect——

Dr. ABEL. There is a digital transmission system.

Mr. EFFROS. But the broadcasters could not do that today.

Dr. ABEL. They can do that today.

Senator GORE. Without interrupting too much, but it seems to me that we are going very rapidly toward a vertically integrated technology with digital cameras, digital sets, digital transmission. I mean, I may be wrong, that is just——

Mr. EFFROS. I would suspect you are right, sir, but that is longer term development than the immediate HDTV.

Senator GORE. If you look at the transition that has occurred in set technology in the last three years, it might give you some——

Mr. EFFROS. I would love to see it happen; I am not saying I am opposed to it.

The second or third concept of HDTV that was talked about today was video imaging and information technology. Dr. Fields was talking a lot about video imaging.

Another concept of HDTV as it related to this discussion was integrated circuits and semiconductors and the impact on them, based on the trickle-down theory of selling HDTV sets. And, finally, the overall discussion was economic policy, American industrial development and so on.

I would just point out one thing. In terms of the theories, particularly the theory of the trickle-down semiconductor, integrated circuit concept, and that is, that theory only works if the consumers want to buy what it is that you are making. There is no evidence to date that that is true. It is interesting that Dr. Fields, in specifying what he thought were the important things to do, said one of them is to educate the public so they will buy, so that we can sell semiconductors.

Now, CATA has been saying for quite some time now, in every forum we could find on HDTV, that the thing that must be looked at very carefully is whether the American consumer really wants to foot the bill for something that there is no convincing evidence is that much of an improvement in an average-sized television in an average-sized home today.

So all of these other great things can happen; they all may be important. The industrial policy is certainly important, the semiconductor industry is certainly important, the information technology is certainly important. But if it is all based on the concept that we are going to make lots of integrated circuits and we are going to make lots of money ultimately down the road by selling HDTV to the public, you had better get the public involved in this. And we have not seen that. And that is what we are calling for.

Senator GORE. Well, in defense of Dr. Fields, I think what he was doing, in that part of his statement, was logically breaking down all of the activities that go into a transition from one technology to another. And I think he said, right after that statement, that he would certainly

anticipate that would occur completely in the private sector as a matter of advertising, et cetera.

Mr. EFFROS. But if we are wrong?

Senator GORE. Yes. Well, it is a good point you raise. I mean, yes.

Senator GORE. Mr. Berge, I apologize for mispronouncing your name at the beginning of the panel. You are vice president of the Telecommunications Industry Association. We appreciate you being here and your patience throughout this long hearing, and please proceed.

STATEMENT OF J. HAL BERGE, VICE PRESIDENT, TELECOMMUNICATIONS INDUSTRY ASSN.

Mr. BERGE. I am delighted to be here today, and I was delighted to get the invitation yesterday. And I am delighted to hear you say that digital is the way we are going, because, certainly in the fiber optics industry, that is what we are promoting.

I am delighted to hear that people are talking about fiber as being an alternate medium for HDTV, because all I have heard up to this point is satellite, cable and video recorders. Fiber is a viable and needed medium, not for just the entertainment market, but as a nationwide fiber network, as you say. Entertainment, yes, but education, medicine, home, factory, office, and school, as you previously mentioned.

There is synergism between HDTV and the fiber optics industry. HDTV is going to require a broad band width to provide the signal necessary for HDTV features, such as picture-within-picture, freeze-frame, digital VCRs, the compact disc and the rest of it. Fiber network growth is at a plateau at this present time, and it can use HDTV as a driver to accelerate fiber to the home.

The advantages of fiber over other means are lower noise, less distortion, larger capacity, less attenuation, immunity to electro-magnetic and RF interference, less size and weight than copper cable, a di-electric non-conductor, and no possibility of cross-talk. Clarity and quality is what we are looking for. We are going to have to sell this TV and it is going to have to be better than what we are looking at today. We have heard of all kinds of improved television, HDTV, ATV and IDTV. We do not want to try and sell an IITV, an imperceptibly improved TV.

We need fiber all the way from the studio to the satellite transmitter over the long haul lines, through CATV trunking and ultimately to the home. The present fiber distribution system, as far as the telephone companies are concerned, is digital voice and data going to businesses, digital voice, data and video to homes on a trial basis, in Orlando and in Cerritos, CA.

In the future, I would expect to see digital broad-band fiber installed to both homes and businesses in telco areas. In cable TV, they are using coax with amplifiers every 2,000 feet at this point. They pass 80 percent of the home and 55 percent of the occupants subscribe. In the future I would see a fiber backbone or trunk, and then a coax dropline to the home. I presume it would be analog; it could be digital. They would get a 70 percent improvement, however, by going to fiber because of the change from a cascade of 28 to only four amplifiers.

The synergism, then, for HDTV and fiber in the cable TV area, lies in the use of analog fiber optic technology in their distribution network which is certainly the way they are going. This distribution network will help HDTV in becoming a success in the near future, 1989 to 1995. The use of digital fiber optic technology in the telephone company network can become cost-effective in the longer term, from 1995 on. Thus, HDTV's implementation can accelerate the growth and vitality of the fiber optic industry.

Now for timing. HDTV receivers, I guess, are going to enter the market in about 1993. It is expected to occupy 30 percent of the national market by 2003, about 13 million sets. Fiber to the home trials are now in progress and fiber is now going into a feeder plant between the central offices and remote terminals in the telephone companies operating areas.

The cost of fiber will equal the cost of coaxial transmission for plain old telephone service in two to five years, by 1995. And fiber is going to be prescribed for new construction in high-growth areas from about 1995 on. Fiber could be in 5 percent of the homes by the year 2000, over 3 million homes. They ought to be able to hook up fiber to their HDTV sets. Southern Bell predicts that it will be all fiber by 2010, a complete network within their area. The Electronic Cast Corporation predicts that 1.5 million homes will have fiber by 1997.

In policy matters, we have some problems. They include cross-ownership restrictions, problems with the FCC, with the Cable Communication Act of 1984, and with the modified final judgment, and there are going to have to be some removal of these barriers in order to get permission to go ahead with the fiber network emplacement.

In conclusion, the advantage of a fiber optic medium will promote the commercial success of HDTV, and HDTV will accelerate the movement of fiber to the home and boost the health of the U.S. fiber optics industry. The system approach is required from the studio to the home, making maximum use of fiber and digital signal quality.

We would recommend that we adopt standards for HDTV, both in terrestrial broadcast and in the interconnection of alternative media, including fiber; include fiber optic technology in measures to assist industry in producing and marketing HDTV; remove the barriers stifling progress in competition among the various media and relax the antitrust lawsenough to enable cooperative work in design and development. Thank you.

[The statement follows:]

STATEMENT OF JAMES H. BERGE, VICE PRESIDENT, FIBER OPTICS DIVISION OF THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION 1/

Good morning, Mr. Chairman and Members of the Subcommittee. I am James H. Berge, Vice President of the Telecommunications Industry Association with primary responsibility for the administration of TIA's Fiber Optics Division. I appreciate the opportunity to appear before this subcommittee today to discuss the role of the National Institute of Standards and Technology in the growth and competitiveness of the U.S. Fiber Optics Industry.

The Telecommunications Industry Association is a full service national trade association representing nearly 600 manufacturers and suppliers of telecommunications equipment. Forty-six of those companies are engaged in the design and manufacture of fiber optic components and systems here in the United States. The 46 corporations are listed in Appendix A to this testimony.

The U.S. is, today, the largest telecommunications market in the world and consequently, the largest single fiber optics market. The U.S. share of the world fiber optics market is currently about 40%, but that share is forecast to decrease as the installation of fiber in Western Europe and Asia outpaces the U.S. over the next five years. This year the U.S. market is expected to reach $1.1 billion of a total world market of $3.2 billion. Over 800 U.S. companies are now involved in the production of fiber optics. Most

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1/ The appendices were not reproducible.

of them are quite small and many are having a very difficult time. The shrinking U.S. share is likely to further intensify competition in the domestic market and lead some U.S. firms to pursue the expanding foreign markets.

The problem is that the long haul installation of fiber by the major interexchange carriers is largely complete and growth in this market has leveled. For instance, the cumulative route miles for long-haul carriers has gone from 20,000 in 1985 to over 80,000 in 1988. At the regional level the seven Bell Operating companies have gone from 18,000 in 1985 to 62,000 in 1988. RBOCs will continue to install fiber along central trunk routes and to major customers in the next several years, but the growth is not predicted to exceed that of recent years. The next frontier and most promising market for fiber optics is the local loop, the subscriber's side of the central office. It is estimated that there is ten times more potential business in this area of the telephone plant than in the interoffice and long-haul plant. Local loops account for 90 percent of the telephone system links in the country. An Electronicast forecast notes that residential sales alone could take a 75% share of a $4 billion fiber optics market by 1995. They also predict that up to 1.5 million homes could be hooked up with fiber optics by 1997. The more conservative estimates would place the $4 billion figure in about 1999.

We in the industry don't want to wait eight to ten years for fiber optic communications to become available to the consumer. We believe that the technology is sufficiently developed and the manufacturing base sufficiently established to move this time period three to five years closer. HDTV is just over the horizon and its success would be greatly enhanced with a signal transmitted over fiber. Incidently, we submitted a report to Congressman Markey, Chairman of the Telecommunications and Finance Subcommittee on February 1st, asking that he include fiber optic technology initiatives to enhance national competitiveness related to HDTV. A copy of that report is included in my testimony as Appendix B. Fiber local area networks will provide the bandwidth for office computer systems using the full capability of an integrated system digital network (ISDN). Our homes and schools can become fully automated with multiple video projections that will entertain, inform and educate. But, we need your help.

Our Fiber Optics Division has been working closely with the National Bureau of Standards, now NIST, for the past ten years in the development of test procedures and specifications. There are now 92 fiber optic test procedures published. NIST has provided the measurement basis for 25 of them. This has been a technology transfer function from its inception. They have defined a standard for absolute measurement of optical power for the

development of light sources and detectors. NIST has completed its first system for high-speed measurement of optical wave forms to support the development of fast optical devices such as optical modulators. They conduct their work at their facility in Boulder, Colorado and they oversee the "round robin" testing that we do at the various laboratories of our component and system manufacturers. Their expertise in lightwave measurement, their extensive laboratory test facilities and their unique professional and objective approach to test and research projects have made their participation and partnership with us invaluable. That support is now needed more than ever. One of the reasons that our industry growth is now relatively stagnant is that the cost of the optical systems that would bring fiber to the home is too high. The price gap between fiber optics and copper cable is closing, but the cost of the total system including key components such as sources and detectors remains too high. There is a driving need to improve reliability, and performance, and to lower costs, all highly measurement dependent aims. Our success in meeting this need will play a large part in deciding how soon we ready fiber for the home and how much market will be left for U.S. manufacturers, here and throughout the world, when we are ready.

Specifically, we request that NIST receive the $2.6 million requested in the President's Budget for FY-90. They intend to apply these funds to the high priority component characteristics

which will increase performance and reliability and decrease cost. In the light source area, lasers and LEDs, they will measure linewidth and wave length to closer tolerances in preparation for research on multiplexing and coherent communications which will increase bandwidth and clarity and reduce costs.

For detectors, the funding will enable expansion to include measurements for electronic noise, characterization of detector amplifier packages, and the fabrication of special detectors to correlate design with noise performance and sensitivity. Improved noise performance will reduce errors in transmission and allow a reduction in the number of repeaters along a fiber communication line. That reduction reduces the cost and increases the reliability of the line.

Fibers, or waveguides, themselves can be improved to better pass the lightwaves through their length. By improving measurement techniques, NIST will be able to point out waveguide defects which will enable the manufacture of improved fiber products. NIST also plans to improve modulators and connectors, all critical to the quality, performance and reliability of a fiber optic communications system. They will be expanding their existing program for characterizing lithium niobate modulators to additional types of pulse code modulators. This work is preparatory to new technology in multiplexing and coherent communications. They will

be expanding their loss measurement work on passive couplers to include measurements for bandwidth and coupling geometry. Couplers must meet rigid requirements for bandwidth preservation to prevent degradation of system performance.

The projects and improvements included in the $2.6 million in funding described above are the minimum required to keep our Fiber Optics Industry moving ahead in technology. I'm not sanguine about keeping up with our overseas competitors who are rapidly expanding as they install their own fiber long lines and local area networks, while we wait for political decisions and technological improvements which will make it possible to expand fiber to business and the home. When it comes to performance, reliability and cost, there are additional steps that must be taken to keep us competitive. Additional breakthroughs in distributing optical signals through switches to multiple users and locations, expanding bandwidth through better wave guides and transmitting techniques, and improving overall system performance are a few that are in NIST's bailiwick. Additional funding beyond the $2.6 million this year or next for projects of this nature would help immensely to keep this industry motivated and aggressive.

Fiber Optics is the communication medium of the future. The largest market is here in the U.S. and we have the manufacturers to produce the product. The technology is still developing, like

any new industry, but the basic capability is here and now, not in the next century. I would urge that this sub-committee do all it can to provide the funding and emphasis so necessary to keep this native industry in the lead as we move forward in this communication revolution.

Thank you for the opportunity to appear before you. I would be pleased to answer your questions.

Senator GORE. All right. Thank you very much, and I want to again express my thanks to all of the witnesses. I will have only a few questions because of the lateness of the hour.

Let me ask you, Dr. Flamm, Japan and Europe now have growing research programs aimed at helping their domestic industries. Japan has added the Japan Key Technology Center programs to its other activities. Europe has so many new research programs, it is hard to keep track of them: Eureka, Eureka 95, JESSI semiconductor project, ESPRIT, and others.

These seem like serious attempts to take over the world lead in key technologies. Am I correct, in your opinion, in saying that these efforts are serious, well-designed, and have the potential to undercut our position in key technologies?

Dr. FLAMM. You are describing an extraordinarily variegated bundle of programs that are organized with different structures. The Key Technology Center in Japan is different from other sorts of MITI programs, for example. I think the main point here is that they are putting serious money into it and have been for some time. The JESSI program, for example—and this is very unofficial—will amount to, perhaps, $4 billion, a not insignificant chunk when you compare it to the Sematech program, which is $1 billion only, of which half a billion will come from the government in the United States.

So I would say, yes, they are obviously very serious about it. On the other hand, it is important to note that we too have been pumping fairly large sums into technology for quite some time, since at least the end of World War II. And we are not in a very good position to point our fingers and say, well, you know, they are out to take over world leadership.

The point is, we were investing sums in technology, we had world leadership for many years; we are losing it now. So I think it is time to look around and smell the daisies, so to speak. Why is it that our lead seems to be eroding in so many areas, when, in fact, we still do spend very considerable amounts of money on technology? Maybe we ought to be reconsidering how we spend that money, how it gets directed, how relevant it is to our commercial technology base. And that is the larger issue I was trying to thrust upon your plate today.

Senator GORE. Well, the legislation I have introduced today calls for the Department of Commerce with the Secretary of Commerce as the individual assigned responsibility, to study those, among other questions, and to report back to the Congress within 90 days on recommendations for a strategic plan to address these questions.

I know you have not seen the legislation and it is unfair to ask you endorse it without you having seen it. You might decline to do so so I will not ask you to do that, but I think that it does represent an approach that is consistent with some of your concerns.

Dr. Abel, on the question of a single standard or multiple standards, broadcasters clearly face the most difficult technical problems in transmitting true HDTV signals. It is easier for cable systems or new VCRs to transmit the broad band width signals needed for HDTV. I am concerned about how we achieve a balance here. I do not want to create a bias in favor of other transmission media, but I also do not want to limit the consumers" right to high-quality pictures.

If the technology developed in a way that allowed a sharper picture quality with some kind of VCRs or cable but still clearly lower quality with the transmission, what would be your view of that result?

Dr. ABEL. We are not in favor of disadvantaging any of our competitors, either, let me assure you. We want to transmit the highest-quality picture that we can possibly transmit and that is our intent. If the competitors come along with something that is of superior quality, as long as this single broadcast standard is there, as it is today, those who come along with improvements, such as super-VHS machines or cable, for example, that comes along with a superior signal quality, they can attach to this single broadcast standard receiver today.

That would be our preferred approach, what we would call a multiport receiver that is capable of taking a VCR output or cable converter box or a satellite dish that would deliver that HDTV picture. But I can assure you that we also are going to do our best, working within the limitations that we have, spectrum limitations that we have, to achieve the highest-quality HDTV. If we can achieve true HDTV picture quality, we are going to do our best to do that.

The companies that are preparing, or the proponents that are preparing these transmission systems, many of them are also working to achieve the highest quality—most of them are working to achieve the highest quality signal that they can possibly achieve for terrestrial broadcasting. And we are supportive of that, and there will be a testing process of those transmission systems, and one will be recommended to the FCC for adoption, as I say, we hope, in 1991 or 1992.

Senator GORE. Did you want to comment on that question, Mr. Effros?

Mr. EFFROS. Only to the extent that, so long as other technologies are not inherently limited by what the government sets as a standard for the broadcast industry, we can certainly understand that the broadcasters are calling for a needed single standard. But as long as other technologies are not limited by that standard, no, we would be totally supportive of that.

Senator GORE. Okay. Dr. Carnes, I want to ask about your proposed two-step broadcasting system. For example, what would consumers see with your first step technology? Would the picture be appreciably better or would it be Mr. Berge's IITV category? What kinds of HDTV sets would the consumer need to get the full benefit of that first step improvement?

Dr. CARNES. We have designed ACTV to solve the paradox of how to get started early but still deliver full HDTV quality in the long run. One of the things we have to understand is that screen sizes that people can afford to buy and the quality of the displays that people can afford to buy for the next several, five or 10 years, is limited to quality that we call EDTV, extended definition TV.

So ACTV-1 is intended to get off the ground quickly. It uses the same channel the broadcasters now use and it will deliver wide-aspect ratio pictures with twice as many scan lines as we presently have. It improves the resolution capability about 30 percent in both the vertical and horizontal, which means that you can have about a 30 percent larger screen, both vertically and horizontally. It eliminates all the artifacts of NTSC, the moving dots and busyness in the picture, and it delivers digital audio.

Now, when the consumer can afford to buy a much larger, high-definition display, then we add a second channel, which is fully digital, and delivers full HDTV quality that, in our demonstration side by side with the NHK production standard type picture, people cannot distinguish the difference.

So we believe we have solved the paradox of how to get in the business early and, in the long run, solve this problem of not requiring that broadcaster deliver inferior pictures, or causing anybody else to deliver less quality than he would have to in order to meet the single transmission standard.

Senator GORE. So the second stage would come across the sets you bought for the first stage improvement?

Dr. CARNES. We would anticipate a multi-port on the back which would allow people to buy a set-top box which would plug in. But it would still have the same size display that he had before.

Senator GORE. What would the cost of these sets be? Would they be cheaper than some of the others proposed? I mean, is that an advantage or not?

Dr. CARNES. The main advantage of our system is that it is easy for broadcasters to get into the business——

Senator GORE. No, I understand that. I am asking about the cost of the set.

Dr. CARNES. The cost of the sets are going to be probably all about the same, all the different proponents.

Senator GORE. Okay, well, now, in penetrating the marketplace, are you going to have trouble selling sets of this cost if the initial marketing effort is an improvement in picture quality that is far less than the full promise of HDTV that has been much bally-hooed.

Dr. CARNES. Well, understand that, no matter what the system that you would pick, you could not be able to see more resolution that EDTV to begin with. We believe that the key here is a lot of programming material in wide-aspect ratio——

Senator GORE. Well, no, I think that, let me challenge that statement right there. I mean, maybe I am wrong, but, with some of the proposals, the architecture is kept open for a while, the system is perfected and then the sets go into the marketplace with the promise of really dramatic improvements in picture quality, equivalent to or better than, but let us just say equivalent to the second stage of your plan.

Dr. CARNES. What happens in the interim with——

Senator GORE. Well, we keep watching what we were watching then.

Dr. CARNES. And we believe that if that happens, that there will be alternate delivery media that will send widescreen, enhanced resolution pictures to the home that are non-broadcastable standards, such as VCRs, imported VCRs, or signals that use too much spectrum to be used over broadcast, would be sent over satellite and that these de facto standards would then confuse the marketplace, it would confuse the consumers who buy these sets and then find out later than they do not work with broadcastable standards. We believe that that would throw a wet blanket on the marketplace. We believe that starting with EDTV is the right thing to do and then, when the displays, large HDTV displays come, then we move to the second channel.

Senator GORE. Well, okay. Mr. Effros, I mean, I think that there is a legitimate question there, but we do not have time to pursue it in depth——

Dr. CARNES. I think, Senator, you have to see pictures to—I mean, this is difficult to discuss——

Senator GORE. Yeah, well, I have seen some pictures. I mean, I have taken the time to look at a lot of the entries here. And I think the IITV question is one that is a danger. I am not saying yours is; I have not seen yours and I look forward to doing that.

Mr. Effros, the written material that you submitted expresses great skepticism about HDTV. I know that others, including Dr. Flamm, not only on this occasion but on other occasions, others share your skepticism. Clearly, the marketplace should determine whether this industry, indeed, grows into a major business or not. And the justification for a pro-active government role includes a projection that, in fact, the marketplace will make that decision.

The Japanese seem to think that the marketplace is going to make that decision. They have not invested between $700 million and $900 million in this technology for nothing. Maybe they are right and you guys are wrong. Given the Japanese track record with products that some people considered wildly impractical and sort of hooted at, and said, "Oh, that will never get off the ground. Walkmans? Who is going to walk around with little foam earphones on listening to music? That is ridiculous."

Video cameras—"The public will never buy them. Too expensive. We have got these film cameras already available; they have already got the projectors and the screens. You know, this is ridiculous."

But you know, they have had a pretty good track record recently. Are they going to fall flat on their faces and look like fools investing almost $1 billion in this new technology?

Mr. EFFROS. I do not claim to be a brilliant prognosticator of whether they are going fall on their face or not. I can say to you, sir, that we have a tendency to look at their successes and ignore their failures. We have a tendency to ignore the fact, for instance, that there was great bally-hoo regarding video laser discs, which are clearly better pictures than anything we have got today.

Yet they failed in the mass marketplace. Why? Because something else came along that was more to the taste of the consumer, that consumer liking, to be able to videotape and time-shift, and so on.

Senator GORE. But they are not completely out of the picture yet.

Mr. EFFROS. No, that is true. They are coming back at the appropriate time. I am not saying that HDTV——

Senator GORE. And they are going to be Japanese, too, are they not?

Mr. EFFROS. Most of them probably will be.

Senator GORE. Okay, what is the next failure?

Mr. EFFROS. In terms of whether the government should choose a particular technology at a particular time as a vehicle to accomplish other goals, i.e., semiconductor industry is the example that has been used here today, all I am doing is raising a red flag that says the consumer today has said that they cannot even discern the difference between an HDTV average-sized television set in an average-sized room at an average distance from a good NTSC or improved NTSC set today.

Is that an appropriate vehicle for us to be using? That is what I am asking. And I do not suspect that my answer or anybody else's answer is going to probitive. All I am saying is it is a question that is very legitimate to ask, and that is why we are raising it.

Senator GORE. Now, Dr. Flamm, you delivered a direct broadside to the intellectual model that underlies most of the enthusiasm for HDTV as a technology of choice. And, after all, it was not the government that came out with this.

It was people in the industry who started looking at the trends and doing these analyses. The industry came to the government and said, "Hey, folks, this is beginning to look like what happened in VCRs and phonographs and ball bearings, et cetera, et cetera." Ball bearings is not the correct example there, but I am looking at Chairman Hollings" list here; I will put it in the record for reference.

[The table follows:]

THE EROSION OF THE U.S. SHARE OF TECHNOLOGY MARKETS

TECHNOLOGY	PIONEERED BY	U.S. COMPANIES' SHARE OF DOMESTIC AMERICAN MARKET (percent)				ESTIMATED 1987 VALUE OF U.S. MARKET (millions)
		1970	1975	1980	1987	
Phonographs	U.S.	90	40	30	1	$ 630
Televisions						
Black & White	U.S.	65	30	15	2	$ 175
Color	U.S.	90	80	60	10	$ 5,150
Audio Tape Recorders	U.S.	40	10	10	1	$ 500
Video Cassette Recorders	U.S.	10	10	1	1	$ 2,895
Ballbearings	Germany	88	83	71	71	$ 1,657
Machine Tools						
Horizontal Numerically Controlled Lathes	U.S.	100[1]	92[1]	70	40	$ 401
Machining Centers	U.S.	100[1]	97[1]	79	35	$ 485
Telephone Sets	U.S.	99	95	88	25	$ 2,000
Semiconductors[2]	U.S.	89	71	65	64	$ 19,100[1]
Semiconductor Manufacturing Equipment[3]	U.S.	100	90	75	75	$ 1,856
Cellular Telephones	Scandinavia/U.S.	--[4]	--[4]	--[4]	40	$ 740
Facsimile Machines	U.S./Japan	--[4]	--[4]	--[4]	--	$ 750

[1] Estimates
[2] Data is for semiconductor merchant companies only. U.S. company share includes production of foreign subsidiaries operating in the United States.
[3] Estimates only. No official data exists.
[4] Not introduced into the U.S. market.

Source: Council on Competitiveness, Picking Up the Pace: The Commercial Challenge to American Innovation, Sept 1988, page 15, using data from the U.S. Department of Commerce.

Senator GORE. Here is the Department of Defense projection of worldwide DRAM usage in computers and in HDTV.

Dr. FLAMM. The years are kind of tough to make out.

Senator GORE. The lines cross, the lines cross at about 1999 with—and this is the number of DRAMs in HDTVs and this is the number of DRAMs in computers.

Dr. FLAMM. Could I comment on those estimates?

Dr. CARNES. What was the number where they crossed? Not the year, but the amount.

Senator GORE. 1.5 billion DRAMs. It is in millions of DRAMS; that is 1,500 million, 1.5 billion DRAMs in the year 1999 in each technology, and then the number of DRAMs in HDTVs accelerates at a more rapid rate. Now, they have done rather extensive analyses of this market. What are your sources of your projections, Mr. Flamm?

Dr. FLAMM. Well, my sources are the same ones that you have had presented to you today and at other hearings. Let me just make a comment on these forecasts. First of all, these forecasts are all over the map, for starters. At the last set of hearings I happened to attend, those that Congressman Markey held, there was a large chart wheeled out which showed an HDTV market, I believe, in the neighborhood of $250 billion of total annual sales from various product segments, and this was in the teens. It was in the year 2013 or 2015 or something like that.I suspect the DOD is using the very largest of these numbers, not the more reasonable ones.

Indeed, there has recently been a substantial scaling back of the projected size of the HDTV market, and much more realistic numbers are produced in the BCG report the AEA just came out with. The arithmetic is extremely simple. The BCG report says, tops, $5 billion worth of HDTV equipment sales in the year 2000. Mr. Pearlman today said 25 percent semiconductor content. Multiply 25 percent times 5 billion and you end up with a number on the order of, a little over a billion.

Senator GORE. What is the worldwide market for television sales today?

Dr. FLAMM. Well, the question was HDTV sales.

Senator GORE. Well, I understand, but as a point of reference.

Dr. FLAMM. I cannot give you that off the top of head. I am quoting you numbers from the AEA report.

Senator GORE. Does anybody here know that?

Dr. CARNES. It is roughly 50 million sets; 20 million in the U.S. this year, 20 million sets.

Dr. FLAMM. Let me just point out a couple of other things. If you look at the amount of memory that is used in computers, it is not static. As the cost of memory has declined, memory use in computers has expanded enormously over the years as well.

And there is every reason to believe that input are going to become increasingly memory-intensive as these very same high-resolution graphics incorporated into HDTV sets will be used first in advanced work stations, fancy graphics boards, and computers, et cetera, et cetera. In fact, as you pointed out earlier, the exact boundary line between HDTV and computers is going to blur.

But I think this whole debate misses a much more important point, which is—if you want to talk about the intellectual model behind this—the initial theory you spun out. It went something like this: to assure that U.S. firms, semiconductor producers, have a market for U.S.-produced DRAMs, you have to have U.S. producers of HDTV sets, i.e., the product that uses those DRAMs.

Senator GORE. No, no, the model is very different from that.

Dr. FLAMM. Then perhaps I missed it.

Senator GORE. The model is as follows. If the Japanese television industry controls HDTV the way they came to control VCRs, then that is likely to give them an advantage in the market for producing semiconductors, designing the architecture for them, specifying their characteristics, and sharing information about what the demand is going to be for various kinds of semiconductors.

Information flow has been a problem, control of key information, control of key technologies, design of subsystems. We have seen that across the board. If they control the design of the ACTV, that gives them an advantage in building and sourcing the semiconductors that will go into the HDTV. Is that a false assumption?

Dr. FLAMM. Not necesarily. Let us grant you that scenario, that technical standards can be manipulated.

Senator GORE. Okay, well, let me go to the next step, then, just so you will understand the model I am working from, and then you can renew your attack on it. I am not——

Dr. FLAMM. Not an attack. Discussion.

Senator GORE. I am not, you know, I am not wedded to it. This hearing is a sincere effort to improve the subcommittee's understanding of this question. A lot of people use this intellectual model. If it is not right, we want to know it is not right.

Now, the first assumption is that control of the ATV set will give an advantage in the construction and sourcing of the semiconductors. Okay, the second assumption is the head start thereby conferred in the construction of those semiconductors will translate into an earlier attainment of an economy of scale, which can then be used as a means of retarding and/or preventing competition, effective competition for the construction of that class of semiconductors. Now, is that likely to be a false assumption?

Dr. FLAMM. Certainly, there are learning economies that are important in semiconductor manufacturing. I will grant you that as well. That is not the point I was trying to make.

Senator GORE. Okay, let me go to the third step then in the intellectual model. If the head start and the economy of scale results in control over the construction of that class and family of semiconductors, and if that family of semiconductors does, indeed, embody a step up in the technology of semiconductors, then control of that family of semiconductors will confer an advantage in the design and construction of other products.

And here we are reversing the flow, we are reversing our direction on the electronics food chain; we are going in the opposite direction now—other products besides HDTVs, which use variants of that particular family of semiconductors, will—the same group of companies will have an advantage in constructing those products. Now, do you challenge that assumption?

Dr. FLAMM. There is a fourth step you have left out——

Senator GORE. All right.

Dr. FLAMM. —in your argument.

Senator GORE. Okay.

Dr. FLAMM. The fourth step in the logical argument is that if the market is open to U.S. semiconductor manufacturers—if there is a market that it is in the position to be able to penetrate—then U.S. firms will enter that market and produce competitively for market. Okay? That is the additional step. In point of fact, today——

Senator GORE. Is it open?

Dr. FLAMM. Well, let us talk about it. Today, the largest user of this product is the computer industry, which is dominated by U.S. firms, but 80 percent to 90 percent of DRAM sales are by Japanese firms, many of them by Japanese firms to U.S. companies which are manufacturing computers.

Why is it that the U.S. semiconductor industry has not gotten into the manufacture of memory chips today when it has precisely the kind of market that you are talking about creating in HDTVs?

Senator GORE. Because, I mean, they are behind on the economies of scale; they are behind on the curve. And the reason that computer manufacturers have not yet been disadvantaged by a difference in the willingness of the Japanese suppliers to give them the semiconductors on a competitive basis may be because they are dependent on us in the area of software.

And if that advantage ever disappears, then the Japanese may very well be much more willing to use the leverage that they have over a Cray, for example. I mean, how did the U.S. companies get knocked out in the first place.

Dr. FLAMM. Well, that is precisely the point. If we are talking about doing something for the semiconductor industry, we ought to be analyzing the concrete problems of the semiconductor industry and trying to do something about it. If they are lagging several generations behind in technology, let us move on that issue.

Senator GORE. But it is not a single dimensional problem. We are moving with Sematech, but we have to recognize that this is an integrated industry, and the control of other parts of the chain will have an impact lower down and farther up.

I mean, if you look at the—I mean, if we took your analysis and your intellectual model, this may be unfair, but this is, let me just deliver my broad side. If we took your intellectual model and applied it to the U.S. consumer electronics industry as it existed 15 years ago, we would say, no problem, and we would not be able to predict what, in fact, occurred.

Dr. FLAMM. But, sir, logically, if the problem is that the U.S. semiconductor industry is starting behind and therefore has higher costs, would it not be a smarter idea to take your capital subsidies or whatever you are talking about doing, and giving them to the semiconductor industry so that it can produce——

Senator GORE. We already have Sematech and we should be doing more on semiconductors. And we should be addressing other aspects of the information industry. And I will introducing legislation, as I said, later this week, addressing several components of that problem.

I do not think we can afford to ignore what the Japanese and many others believe is likely to be the single largest volume new consumer electronics product in the entire world. Because if we are going to be making semiconductors, we have to know what we are going to be producing them for and who we are going to be producing them for. I do not think we can afford to ignore those kinds of things.

But, anyway, you can all elaborate for the record, if you want to, on these questions because we are going to ask further questions for the record and give you a chance to respond.

I appreciate, we have got to vote on another similar related issue on the floor right now. I would like to thank all of our witnesses and all of our guests. Our subcommittee intends to remain very active in this area. We will be having further hearings later this year and we appreciate all of you helping us today.

[Whereupon, at 5:35 p.m., the subcommittee was adjourned.]

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

STATEMENT OF JOHN J. SIE, SENIOR VICE PRESIDENT, TELE-COMMUNICATIONS, INC.

Introduction

My name is John J. Sie and since 1984 I have been Senior Vice President of Tele-Communications, Inc. (TCI), a cable company headquartered in Denver, Colorado, which operates cable systems throughout the country.[1] TCI also has invested in cable programmers in furtherance of its commitment to provide American cable viewers with a wide range of quality entertainment and information programs in addition to retransmitted over-the-air programming. At TCI, I am responsible for strategic planning, public policy and program investment.

Approximately 55% of American television households (49.5 million) receive their television signals through a cable system. Accordingly, the cable industry is vitally interested in proposals regarding HDTV and we appreciate the opportunity to testify this morning. (I will use HDTV in the same general way the the FCC uses ATV.)

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[1]Frankly, I have been a "closet technocrat" for the last 15 years. My education and early career development were technical. I received my Bachelors degree in Electronics in 1957 from Manhattan College and my Masters degree in electrophysics from the Polytechnic Institute of Brooklyn in 1958. My technical career started in 1958 at RCA's Defense Electronics Division as a senior member of Technical Staff, working on microwave solid state devices for troposcatter and satellite communications. In 1960, I co-founded and was later President of MicroState Electronics Corporation, a subsidiary of Raytheon Company. Microstate did R&D and manufacturing work for the space and defense industries in areas of advance solid state devices for missiles, radars, and telecommunications. In 1972, I joined the Jerrold Subsidiary of General Instrument Corporation where I developed two-way interactive cable TV, multi-channel and addressable pay-per-show TV scrambling systems. In 1977, I joined Showtime Entertainment, a subsidiary of Viacom International, Inc., as Senior Vice President of Marketing and Affiliates. Showtime is in the business of providing movie based pay-TV services primarily to the cable industry.

The Importance Of HDTV

As Chairman Gore and the other members of this Subcommittee have recognized, HDTV means more to America than television pictures with video quality comparable to 35 mm film and with compact disc quality sound. Over the longer term, there also are expected to be many non-entertainment uses for the high resolution video technology, including: interactive education; computer work stations; satellite photography; defense command and control displays; advanced weapons targeting; and medical diagnostics. Most importantly, if the U.S. Government takes the right actions, then American HDTV in the 21st century will use the most advanced integrated circuits and computer processes in a home environment. Whoever takes the lead in HDTV technology will have the advantage with respect to key components (semiconductors, etc.) and in related areas of computers, software and test equipment.

In short, we applaud the Commerce Committee for its recognition that the HDTV competition represents a bigger challenge to our technological leadership in the world than did the color television or the VCR. Decisions made now will affect our place in the world well into the next century.

What The U.S. Government Should Do

The noted management consultant, Peter Drucker, has been quoted as saying that a competitor should never try to catch up -- instead he should "leap frog" the current leader. We could not agree more.

Specifically, we call upon the U.S. Government to:

(1) set a national goal of introducing by the year 2000, an American "processed digital" HDTV system which permits the transmission of a digital-HDTV signal within 6 MHz;

(2) support efforts already underway in the private sector to develop and implement a processed digital transmission system;

(3) promote the introduction within two years of an interim analog-based HDTV system which uses the current 6 MHz NTSC standard, so that the more than $100 billion invested in broadcast and cable transmission equipment, television sets and VCRs will not be rendered obsolete;

(4) reserve frequencies allocated for television broadcasting, but not currently utilized, for processed digital HDTV during the transition period when broadcasters will simulcast compatible analog HDTV and non-compatible digital HDTV signals.

These combined actions will:

- thwart attempts by foreign countries to introduce non-compatible HDTV systems in the U.S.;
- ensure that American viewers have access to improved television pictures quickly;
- minimize the cost and disruption associated with introducing HDTV; and
- maintain the ability of American broadcasters and cable operators to provide local and national news, information and entertainment programming.

Why the U.S. Should Focus On Digital-Based HDTV

Analog-based HDTV systems will not be competitive in quality or cost with the next generation of digital-based HDTV systems. For the purposes of television signal transmission, "digital" simply means converting an analog HDTV waveform to a series of binary bits of 1's and 0's.

Digital-based HDTV will offer the same revolutionary advancement we have achieved, by way of analogy, with compact discs and digital audio tapes versus standard LP's. A digital signal:

- suffers from no transmission degradation;
- enables true studio quality image and sound in American homes;
- permits direct integration and signal manipulation between the home television and home computer; and
- promises volume-efficient cost reductions in manufacturing digital HDTV sets.

Furthermore, developing an American digital-based HDTV system lets us "leap-frog" the Japanese MUSE and European EUREKA HDTV systems which are analog-based transmission systems. U.S. entities have the lead in developing digital-based technology. This work both relies on and contributes to the U.S. leadership position in VLSI circuits, micro processors, software systems and adaptive compression techniques.

Why the U.S. Should Focus On a "Processed Digital" System

1. What is "Processed Digital"?

A "processed digital" HDTV transmission system can be defined as any digital-based HDTV television transmission system which reduces the frequency spectrum required to transmit a signal by taking into account three major factors:

a) standard digital compression transmission techniques; and

b) the specific nature of the video waveform; and

c) the neural responsiveness of the human eye.

2. A "Brute Force" Digital Approach Employs Only Standard Digital Compression Transmission, Requires Excessive Spectrum, and Would Terminate Local Broadcasting

Before discussing the design of processed digital, let's first look at transmission systems which only use standard digital compression techniques.

Digital telecommunication systems today routinely exhibit bandwidth compression efficiencies of 4.5 Bps/Hz: for every 4.5 bits of data, we need only one cycle of radio frequency (RF) spectrum to transmit them. For example, a 4.5 Mbps data stream can be transmitted using only one MHz of RF bandwidth. Most

digital long-haul microwave transmission systems achieve this compression efficiency using a 64-level quadrature amplitude modulator (QAM). As higher levels (256 - 1024) become available on the market, further bandwidth compression of up to 7.5 Bps/Hz is possible with appropriate error corrections..

Now let's design an HDTV system with the following characteristics: (1) a resolution of 1050 x 1050, i.e., the whole screen is capable of resolving into small cells called "pixels," 1050 vertical by 1050 horizontal so that the total number of pixels per screen is 1,102,500; (2) the screen is scanned at a rate of 30 times per second (in order to show continuous motion) with a 2:1 interlace scan; and (3) there are 5 binary bits of information each required to define the intensity (luminance) and color (chrominance) content for each pixel. The total amount of digital information needed to be transmitted every second in this system is 1,653,750,000 bits! Even using a transmission compression of 7.5 Bps/Hz, the required RF spectrum is 220.5 MHz for just one channel of HDTV programming!

Such a "brute force" approach using so much spectrum for digital HDTV is not suitable for over-the-air transmission: there simply is not enough spectrum available without creating new demands on other spectrum users (e.g., land mobile radio, public safety radio, etc.)

This is a serious drawback: it effectively would mean the end of the local broadcastings in the HDTV arena. Local broadcasting has been a hallmark of American television policy since its inception.

The only way to transmit such signals would be through fiber-optic cables. But it would be extremely expensive to install such cables throughout the country and telephone companies would not be able to lay fiber universally to every American home until well into the 21st century. In addition, there are serious technical questions about even the feasibility of transmitting more than a few HDTV channels requiring such great bandwidth even with fiber-optic cable: within the foreseeable future, the state of the art in video switching using sub-micron integrated circuit technology is below 1 Gbps, or at best each video switch at the remote terminal can only handle 4 HDTV channels. Moreover, at a 1 Gbps switching rate, the cost of such switches are not going to be competitive at all.

3. A "Processed Digital" Approach Greatly Reduces The Necessary Bandwidth

The brute force digital approach described above, utilizing 220 MHz bandwidth, is capable of faithfully reconstituting all ranges of intensity and color for every pixel for every frame. But it is not necessary to do so given the nature of video images and the limitations on the ability of the human eye to perceive such information.

Even with the most detailed scene and fastest motion, much of the content information from pixel to pixel and from frame to frame does not change. (A crude example of my point can be seen by advancing a videotape on a VCR frame-by-frame.) Therefore, instead of sending each pixel of each frame new information every time, the processed digital system only sends new information when there is a change. By doing so, much less transmission spectrum is needed.

Furthermore, the pixels can be grouped into cells of several pixels each, further reducing the necessary bandwidth. A receiver can have the adaptive capability of interpolating the proper information for each of the pixels in each group from the coded "change" information being received and processed. The reconstituted image will be perceived by the viewers as having the full resolution.

Because of these factors it is possible to drastically reduce further the spectrum needed -- that's the "Processed Digital" approach. Indeed, we believe that a processed digital signal need not require more RF spectrum to transmit than the current NTSC signal.

We engaged Hatfield Associates, Inc. (HAI), under the direction of Mr. Dale Hatfield, to assess the likelihood that, over the next ten years or so, a processed digital HDTV signal could be transmitted via terrestrial broadcasting and cable systems within a 6 MHz RF bandwidth. Their conclusion is that even using today's

available technology, such a goal can be achieved. (For the Subcommittee's reference, the March 20 Hatfield Assessment and March 28 Addendum are attached.)

In the very near future we hope to bring together the best scientific minds in this country to review this conclusion and to discuss how it can be achieved!

Work is Already Underway Around the Country on Processed Digital

Many scientists in research labs and industrial enterprises are hard at work developing different variations of the processed digital approach.

This, of course, has been the traditional American way of engineering: separate and competing laboratories. However, given the national importance of developing an American processed digital HDTV system, we believe it would be appropriate for the Federal Government to assist these efforts.

Of note are Professors William Schreiber and Andy Lippman of MIT's Media Lab, Arun Netravali and Barry Haskell of AT&T Bell Laboratories, and Arthur Kaiman and Lawrence Ryan of Intel's DVI Program in Princeton, New Jersey.

DVI's work is particularly interesting. It is an advanced technology which combines the interactive graphics capabilities in personal computers with high-quality television and multitrack audio in an all-digital integrated system. At the heart of the system is a proprietary chip set with a unique video compression algorithm. A technical breakthrough in compression efficiency was

announced by DVI in 1988 -- they can microcode one hour of full NTSC television programming on one CD-ROM disk, heretofore thought to be impossible. The chip set and the associated operating software can be in three plug-in boards to PC/AT computers. The DVI system is used for interactive video program designs. It has a real time video compression capability of 30:1 by removing redundant pixel to pixel information within each video frame. This is called intraframe coding. Once the interactive video/date/audio application program is completed, the program can be further compressed by removing interframe redundant information. This would require much more computing and storage capacity and is done off line. Interframe coding of DVI technology can offer another 4:1 compression yielding a final CD-ROM disk containing 1 hour or NTSC video with 120:1 compression.

Although the DVI's current application is institutional for education and training, and the cost of the prototype system is about $25,000, it is not hard to project what can be done as we continue to improve processed digital, transmission compression, and cost reduction of large capacity memory storage devices in the next 10 years. (Consider: Intel's workhorse microprocessor 80386 has computing capacity similar to the IBM large mainframe computer 360/50 of twenty years ago! Intel is already developing the next generation microprocessor with at least 10 times more capacity than the 80386.)

Quantitatively, a 1.65 Giga bits per second of digitized HDTV signal with a video compression of 120:1, a transmission modulation

compression of 5:1 and a 33% capacity for forward error correction would need only 3.65 MHz!

The U.S. Should Promote the Introduction Within Two Years of an Interim Analog-Based American HDTV System Which Uses the Current 6 MHz NTSC Standard

Japan's MITI and its National Broadcasting Company (NHK) have been trying hard to persuade U.S. policymakers that they are the only ones with a HDTV system and are ready and able to make it available to U.S. consumers. What they downplay is that their system is incompatible with existing U.S. television transmission equipment (broadcasting and cable) and television receivers, all of which work with the current NTSC standard of 525 lines, 59.94 Hz frame rate, 4:3 aspect ratio, and 6 MHz transmission standard. Thus, it is not hard to see the Japanese's true objective: the sales of new Japanese HDTV sets full of Japanese components. Yet, there is no need to suffer such problems.

An American HDTV system exists now (Faroudja's Super NTSC) which is NTSC compatible and provides as sharp a picture as the full, original MUSE system for the largest of American television screens (six-foot diagonal).[2] The improved effect of the analog

[2]Since the FCC's tentative decision last year requiring compatibility with NTSC receivers, NHK has tried to modify its MUSE system. But picture quality has been significantly sacrificed, the system is expensive, and even the Japanese terrestrial broadcasters don't like it!

HDTV signal only appears on new television sets; but Americans will be able to receive improved pictures on the existing 160 million television sets because Super NTSC reduces artifacts (wiggles) and color distortions. Moreover, costs of a new Super NTSC TV set will be less than that of alternate systems because of its compatibility with the NTSC standard and successful use of VLSI chips.

Importantly, because broadcasters and cable operators can easily send the more advanced signals over the same bandwidth as an NTSC signal, the number of programs with a sharper image and digital quality sound available to the viewer is maximized. Maintaining the current 6 MHz transmission standard also permits broadcasters and cable operators to continue fulfilling their important role in providing local coverage.

The immediate and universal availability of the best in broadcast and cable programming in 35 mm picture quality and compact disc sound with reasonably priced HDTV sets will capture the consumer market and blunt the threat of incompatible foreign VCR's and TV's with questionable "software" (recall the commercial flop of Super 8 and Super VHS for the same reason).

In just the last few months, Faroudja has successfully demonstrated the Super NTSC system in a variety of settings.

In February, 1989, Faroudja was invited to Japan by their privately owned commercial broadcast networks. These networks are understandably resentful of NHK's plan to bypass terrestrial

broadcasters for HDTV by DBS, VCR and video discs. Moreover, since it is becoming clear that the Europeans, and now the U.S. will not accept the MUSE system, they are increasingly less willing to sacrifice for any "greater good." They invited Faroudja because his Super NTSC system is better and more advanced than their own NTSC compatible HDTV systems. Faroudja's demonstrations were a hit: he stayed longer and had far more attendees than had been expected.

A month ago, Faroudja successfully demonstrated Super NTSC on a TCI cable television system in Sunnyvale, California. The experiment involved side-by-side comparisons of a standard NTSC signal transmission and the Faroudja Super NTSC transmission through the Sunnyvale cable system to receivers in City Hall. The result was a remarkable improvement in picture quality when using the Super NTSC process. Frank Haney, a technical executive with Capital Cities/ABC, watched the demonstration as an invited, objective observer, and concluded that "Super NTSC looked more like film that TV." (A copy of his comments on the demonstration is attached.)

At the NAB convention at the beginning of this month, Faroudja demonstrated his system with a UHF transmission with digital sound -- again to rave reviews. The Super NTSC signal was broadcast throughout the Las Vegas area and received on standard NTSC receivers as well as HDTV receivers at the Convention.

Finally, Mr. Chairman, I want to note that John Malone, President and CEO of TCI, announced at the NAB convention that

within one year, at a site to be selected, TCI plans to invite local broadcasters to join in a major operational test of this analog, NTSC-compatible, HDTV system. TCI will equip its cable system in the locality with the necessary equipment and will actively seek one or more local broadcasters who would be willing to invest in transmission equipment as well. Moreover, if computer chip and U.S. television set manufacturers are willing to cooperate, we believe a limited number of modified HDTV sets can be available to consumers in the test locality for rent or purchase by the end of 1991.

In short, maintaining the current 6 MHz NTSC standard for analog-based HDTV will bring sharper pictures with a greater number of programs to more American viewers in the shortest time and at the lowest cost.

The U.S. Government Should Reserve Unutilized Television Frequencies for Simulcast of Analog and Digital HDTV Signals

As we have explained, there is no need to deviate from the existing 6 MHz transmission standard in order to bring the benefits of HDTV to the American public.

Yet, in September, 1988, the FCC left open the possibility of changing the standard for HDTV broadcast to permit the use of up to an additional 6 MHz -- as long as the additional bandwidth was found within the spectrum currently allocated to television

The problem is that permitting analog-based HDTV signals of more than 6MHz within the existing television spectrum would be impractical and disruptive, requiring costly channel reallocations and preempting available spectrum for the next generation of digital-based HDTV systems.

Remember: the ultimate goal is adoption of a digital-based HDTV signal. This necessarily will be incompatible with any analog television set. Thus, there must be a transition period. By reserving frequencies allocated for television broadcasting, but not currently utilized, for processed digital HDTV during this period, broadcasters will be able to simulcast compatible analog HDTV and non-compatible digital HDTV signals. Thus, the United States will be able to make the transition easily, with minimum cost and disruption, to a processed digital system that will serve us well into the 21st century -- just as the NTSC standard has served us well in the last 40 years.

Conclusion

We at TCI believe that a very intense, well coordinated and well financed effort, bringing together the best minds in video processing, film technology, VLSI, solid state memory technology, microprocessor software, bio-engineering, visual psychophysics, and visually creative programming expertise would rapidly accelerate the state of the art to bring the most advanced, competitive, and cost effective processed digital HDTV system for the 21st century.

There have been may suggestions as to how the Government can help: decisive standard setting; antitrust relief for joint efforts; matching grants; tax credits; etc. We think this Committee and the Congress should continue to examine these alternatives. But we can and should agree as soon as possible on what we should do: introduce by the year 2000 an American processed digital HDTV system which permits the transmission within a 6 MHz bandwidth.

Statement

of

Jerry A. Korn
President
Rubicon Systems, Inc.

before the

Committee on Commerce, Science, and Transportation
United States Senate
Washington, D. C.
May 16, 1989

Mr. Chairman and Members of the Committee:

I am pleased to have this occasion to share with you some thoughts concerning an exciting opportunity to regain an industry that we have essentially lost to the Pacific Rim Countries and to use it as a base to build a strong domestic consumer electronics industry. I am speaking of the opportunity being availed to the U.S. in the area of high definition television (HDTV).

The advent of HDTV will generate the need for new television receivers, new video recorders and new broadcasting equipment thus allowing "the decks to be cleared" as to competition. The semiconductor technology developed for HTDV will become the basis for a strong downstream business in the consumer electronics industry. The Japanese have been working on HDTV since 1984 when they introduced a transmission protocol called Muse. The original intent of Muse was to provide a mechanism for HDTV images to be sent to a totally new generation of consumer receivers via direct broadcast satellite (DBS). Compatibility with the current standard, National Television System Committee (NTSC), was never intended or even desired; the broadcast environment in Japan is substantially different from North America, and Muse was designed with the Japanese environment in mind. Since the orginal Muse requires additional spectrum for broadcasting, the Japanese equipment will not be compatible with the approximately 125 million NTSC receivers in North America. The Japanese have subsequently modified their technology to incorporate a version (Muse-6) that is NTSC compatible over a single channel; however, the quality of the picture is far from that of true HDTV.

There have been numerous HDTV techniques proposed during the past few years, some of which have been modified since the Federal Communications Commission (FCC) decision in September, 1988 that HDTV must provide for continued service to existing NTSC television receivers, at least during some transition period to

HDTV. All true HDTV quality techniques proposed by domestic companies require the use of additional frequency spectrum due to their incompatibility with the NTSC standard. With these techniques, the NTSC picture is transmitted on the existing assigned channel and either augmented information to be added to the NTSC picture or a separate HDTV picture is transmitted on an additional channel. As a result, the FCC has continued a freeze on new television station applications and allotments in 30 major urban areas to ensure that the presently-allocated spectrum is not further encumbered until there is a better understanding of the spectrum requirements of HDTV. For similar reasons, the FCC decided to hold in abeyance requests from land mobile interests for an additional portion of the UHF television spectrum. These techniques are based on the assumption that NTSC transmissions will cease in the not-to-distant future as part of the transition to HDTV, thus freeing the existing NTSC channels for other use. This assumption requires that every viewer trade up to a HDTV receiver in order to receive terrestrial broadcasting. Will the public go along with this? I do not think so. Black and white television sets are still being purchased in substantial quantities some 30 years following the introduction of color.

There is an alternative. Just as American ingenuity developed a color television system that is compatible with black and white, the capability exists to develop a HDTV system that remains compatible with color and monochrome television. The problem is that it is a very risky endeavor, for it is much easier to develop a multi-channel system and trade off additional spectrum for receiver complexity. What is needed is an organization that is set up for the express purpose of developing a single channel, NTSC compatible HDTV system.

The American Electronics Association (AEA) submitted a detailed proposal for government action in advanced television (ATV) to this committee last week at its May 9, 1989 meeting. This proposal is overly complex, fraught with management nightmares and cost prohibitive during today's federal budget squeeze. Whereas the premise is correct, the implementation is faulty.

The optimum situation for implementing the development of a U.S. ATV industry is through well-funded, entrepreneurial companies. As you know, U.S. entrepreneurial companies are responsible for the vast number of new technological developments in the past decade. These same companies have also created the greatest percentage and overall total of new jobs for American workers. Apple Computer, Compaq, Microsoft and Lotus are just a few entrepreneurial companies that have turned the computer world upside down during this decade, and have helped keep America in the forefront of technological developments.

There is a way that Congress can help entrepreneurial companies like Rubicon Systems to implement this development. Legislation can do much to stimulate the design, development and manufacture of high definition television technology through tax incentives for research and development.

As I mentioned above, the development of a single channel, NTSC compatible HDTV system is a risky. I propose that the following legislation be passed immediately in order to encourage investment in this type of endeavor:

* Any return on an investment in this development be non-taxable for ten years;

* In event of failure, the investment be 100% deductible from ordinary income;

* The investment tax credit be reinstated for this development.

Time is of essence. The Rubicon Systems team has begun development of a single channel transmission system that does not require the utilization of the associated "taboo channels" for HDTV transmission, the use of which would severely limit spectrum availability for cellular telephone needs.

The implementation schedule of HDTV is strictly up to the industry. With a sufficient amount of funding, a product can be introduced to this industry in the 1990-1991 time frame.

I am convinced that we need not surrender our leadership in those industries in which we continue to operate and we <u>can</u> regain our lost leadership in an industry such as the video arena.

Thank you.

ASSOCIATION OF
MAXIMUM SERVICE TELECASTERS, INC.

1730 M STREET, N.W., SUITE 713 / WASHINGTON, D.C. 20036 / TELEPHONE (202) 457-0980

MARGITA E. WHITE, PRESIDENT

May 23, 1989

The Honorable Ernest F. Hollings
Chairman, Senate Committee on Commerce,
Science and Transportation
SR-125 Russell Office Building
Washington, DC 20510-4002

Dear Chairman Hollings:

The Association of Maximum Service Telecasters, Inc. ("MST"), asks that this letter be made part of the record of your Committee's hearings on Industry-Government Cooperation to Speed the Commercialization of New Technologies held on May 9, 1989. Attached to this letter is a brief description of our organization, representing some 250 local television stations, which for over 30 years has been dedicated to preserving the ability of local television stations to provide their communities with the highest-quality, free, local and universal television service.

Consistent with this commitment, we are concerned that the emerging national debate on HDTV issues may not be giving due consideration to the American public's stake in enabling its local television service to participate in the new HDTV technologies. This is a compelling public-policy priority because, in seeking to convert their services to HDTV, local broadcasters face a unique handicap among all the media with which they compete: they alone are constrained by a 6-MHz-wide channel imposed by government regulation.

Yet the service provided by local stations constitutes the unquestioned backbone of our national communications system. Free, local and universally available television is the most pervasive and relied upon of this country's news, information and entertainment sources. Even in cable homes 75% of the viewing is of broadcast television stations, not special cable services.

Accordingly, we believe it is appropriate for the government to assist the transition of the American public's free, local television service from current-day technology to HDTV by (i) providing adequate spectrum and interference protection, (ii) setting technical standards, and (iii) perhaps offering appropriate tax relief. Toward this end, we plan to provide Congress with a specific set of requests for government action as soon as our studies permit us to be more concrete.

OFFICERS AND DIRECTORS ON REVERSE SIDE

However, we also wish to reassure Congress that broadcasters have been working vigorously on the HDTV issue for a number of years, have been and are spending substantial sums to investigate various HDTV technologies and are prepared to make additional very substantial expenditures to convert their current service to HDTV.

I.

As long as 15 years ago, our organization was urging the United States to take a position on spectrum in international telecommunications treaty negotiations that would have enabled local broadcasters to experiment with and, as appropriate, implement advanced television technologies. In 1981, MST and other broadcasters urged both Congress and the Commission to set aside spectrum for this purpose. In the early and mid-1980s, we sought to preserve for local-station HDTV spectrum that is already allocated for television use. The Congress assisted us in this struggle. And eventually the FCC was persuaded that high definition television was a high-priority communications policy.

II.

In the past several years, broadcasters have committed to and launched, in the form of the Advanced Television Test Center, a comprehensive, objective and expedited testing plan for HDTV systems that will entail expenditures of more than $10 million. Only through such scientific testing can we, the government, equipment manufacturers and others make the informed decisions necessary to plan for the transition of our national communications system to the new technologies. In this testing effort broadcasters are working with the FCC, the Commerce Department, DARPA and other government agencies, and with equipment manufacturers and the cable industry programmers.

On a separate but related front, broadcasters also have invested millions of dollars as support or seed money for proponents of a variety of different HDTV systems which are in their experimental or developmental stages -- not because of the possible, very modest economic returns involved (if any), but in order to stimulate the development of the best possible HDTV service for the American public.

III.

Broadcasters seek an HDTV system that will achieve high technical quality both now and via further improvements in the future, will protect consumers' investment in existing sets, will be suitable for cable carriage and will provide wide-area coverage to all of the country, including rural areas. A local-station

HDTV system that meets these objectives will require broadcasters to invest in expensive plant and equipment, costing as much as $10 to $40 million per station. Considering that there are over 1,000 television stations in the United States, this is impressive evidence of broadcasters' commitment to providing their communities with service of high technical quality.

* * *

A month ago, Secretary of Commerce Mosbacher addressed our membership meeting on the subject of HDTV and in his introduction we made the following points which summarize broadcasters' convictions on this vital issue:

> "Much is not clear about HDTV but this much is clear: This country cannot afford to disenfranchise those who cannot or choose not to pay for what has been free -- entertainment, the coverage of major national events, sports, and vital information.
>
> "We will not cripple the only portion of our national telecommunications system which recognizes a continuing obligation to serve the public's needs and interests in return for its use of the spectrum.
>
> "We will not weaken or cripple the only segment of our nation's communication, software, news and information system which cannot be subverted by foreign interests -- which cannot be owned or controlled by overseas firms or individuals.
>
> "Indeed, we broadcasters are in the midst of making the strongest possible case by investing our time, our money, and our creativity. We are wholly committed to a free and universal, uniquely American over-the-air broadcast system which we intend to be fully competitive in the coming era of high definition television."

Respectfully submitted,

Joel Chaseman

Enclosure

STATEMENT OF

THE NATIONAL CABLE TELEVISION ASSOCIATION

The National Cable Television Association is pleased to submit these views to the Subcommittee as it looks at the development of high definition television. NCTA represents more than 2,700 cable television systems serving more than 80 percent of the 50 million cable households in the United States, and 56 programming services engaged in creating and packaging a great diversity of cable television programming.

The much-heralded introduction of advanced television (ATV), or high definition television (HDTV), promises to revolutionize not only the look of television but the technology of television well into the next century. Indeed, the sophisticated techniques devised to deliver HDTV's extraordinary picture and sound quality will dramatically effect the telecommunications and consumer electronics industries world-wide. The technology also will have diverse applications to a variety of other fields, including computers, defense systems, medical imaging, space exploration, education, and publishing.

Given the potential impact that advanced television technology will have on the future global economy, the widespread interest in using the technology as a means to revive the U.S. consumer electronics industry and related industries is understandable. In fact, to some, HDTV presents an unparalleled opportunity for American businesses to "get back in the game" by stemming the migration of television manufacturing and assembly abroad. In their view, if American companies do not seize this opportunity, they will inevitably cede the technology and its economic benefits to their Far Eastern and European counterparts.

The development of HDTV could indeed have far reaching benefits for the American economy. Presently, there exists some debate over whether these benefits are necessarily linked to U.S. ownership of the HDTV technology. A home grown technology could be beneficial insofar as it stimulated domestic production and manufacturing of semiconductors, high definition receivers and other component parts. And a focused U.S. research and development program could be important to minimizing U.S. dependence on foreign sources for national defense systems. It also has been suggested, however, that even if U.S. companies owned the HDTV proprietary rights, they might still choose to manufacture overseas, where there are lower wages and an existing degree of specialization in components and subassemblies. Conversely, a foreign-owned HDTV technology could contribute to the U.S. economy if a major share of the value added in research, development and manufacturing utilized domestic labor, capital and other resources. Revitalizing the U.S. industrial base through HDTV, if it can be done, will clearly involve analysis of very complex economic and policy issues regardless of where the technology originated.

The cable industry appreciates the significance of the economic, international trade and national security ramifications of HDTV. We also recognize that a national strategy involving both private industry and government may be necessary to facilitate a major U.S. role in the HDTV future. Over the past several months, various legislative initiatives -- including research and development assistance, antitrust exemptions, and

industry joint ventures or consortia -- have been proposed by consumer electronics manufacturers, policy analysts and some members of Congress. The proposals are currently being studied by the Department of Commerce and other agencies and by the Congressional committees with overlapping jurisdiction in this area. While we have no specific recommendations regarding these initiatives, we urge Congress to give careful study and consideration to the various ATV strategies before taking any definitive action.

During this process, the government should foster a climate in which the American public can enjoy the benefits of this new innovation in the foreseeable future. This means that Congress and the Federal Communications Commission should allow the relevant industries to continue to move ahead in developing and providing new technologies and services to the public. In doing so, the FCC may need to adopt some minimum standards to ensure compatibility among alternative media and to promote consumer acceptance of the new technology. But the video delivery media working together should be left free to determine how best to make the transition from today's NTSC technology to a new advanced television format for the nation's approximately 90 million television households.

STANDARDS ISSUES

In analyzing standards for advanced television, it is important to keep in mind that there are three distinct components: production, transmission and display. Production

involves how the HDTV picture is created and recorded by studio equipment; transmission involves how the picture information is transported from the origination site to the display site; and display involves how the HDTV image is ultimately viewed on the television receiver.

1. Production

Initially, the "1125/60" HDTV format, developed by the Japan Broadcasting Corporation and modified by the Society of Motion Picture and Television Engineers, achieved a very high level of acceptance in this country and in other parts of the world as a studio production standard. It was approved by the Advanced Television Systems Committee and accepted by the National Standards Institute. With increased research and development of various HDTV transmission systems in North America and Europe, however, support for the 1125/60 format as a world-wide standard has increasingly been challenged.

While the new production standard proposals may have certain benefits in certain transmission environments, they have not as yet been subjected to the same rigorous testing and review process that the 1125/60 format has endured. Until they have undergone this process, current acceptance of the 1125/60 format as a studio standard remains appropriate. Moreover, although there is some relation between production and transmission, selecting one or another production standard would not necessarily preclude adoption of any particular transmission format. Just as source material today is transcoded from one

format to another, that same capability would be present in an HDTV environment.

The important point is that achieving uniformity in production formats will ease the transition to HDTV among the various transmission systems. In that regard, NCTA supports ongoing U.S. efforts in the International Radio Consultative Committee (CCIR) to identify a uniform world-wide production standard for international program exchange.

We now turn to the more difficult question of how the various U.S. video delivery media will transmit and display HDTV programming to American consumers.

2. Transmission and Display

The implications of emerging HDTV technology are of great concern to all of the competing distribution media. Each video provider -- broadcast, cable, satellite, microwave, and VCRs -- wants to provide the best service it can to consumers. And each recognizes that it possesses different characteristics and capabilities that should be taken into account in developing HDTV systems.

Toward these goals, the cable industry is participating in the work of the FCC's Advisory Committee on Advanced Television Service and the FCC's ongoing advanced television inquiry. Our interest and active participation in that process is reflective of the important role that cable television plays in the delivery of television programming to the public. Indeed, besides its own television services, cable technology is the means by which 54

percent of American television households receive broadcast television programming. Thus, the broadcast and cable industries are working together to define an advanced television system that will achieve both high quality broadcast transmissions and cable retransmissions of broadcast programming.[1/]

Apart from its role as a conduit for the delivery of broadcast signals, cable provides diverse programming services on a subscription basis. Consistent with its history of providing new and innovative services, cable should be able to be responsive to its subscribers' desires in the new advanced television world. The FCC has implicitly recognized this by concluding that it will not retard the introduction of advanced television systems by nonbroadcast media. Similarly, we would urge Congress not to take any action that would impede cable's ability to provide its subscribers with the best service that it can deliver.

As advanced television evolves, it may turn out that one transmission standard is optimal for all media. However, as we have noted, the peculiar characteristics of each delivery medium may favor the development of a family of transmission standards that converge at the television receiver end.[2/] Since the

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1/ It is generally agreed that the adoption of a single ATV standard for broadcast television will facilitate that industry's ability to take advantage of new technological developments.

2/ For example, unlike terrestrial broadcast programming, which is meant to be generally available to all homes, cable television is a subscription programming service. The cable

(Footnote continues on next page)

display standard is largely independent of the transmission format, HDTV television sets can be designed to accommodate different transmission standards. In fact, there are several approaches under study, which are discussed in the next section, to interconnect different transmission formats to a single television receiver display mode. This will ensure that consumers are not confronted with a confusing array of incompatible standards.

At present, there are a variety of options open to the communications industry in developing HDTV transmission standards. Each makes different trade-offs in picture and sound quality depending on the techniques it employs and the bandwidth it utilizes. In evaluating the systems for cable carriage, the cable industry will look to those systems that provide the highest quality signal in the most spectrum efficient manner. Spectrum efficiency is important because there is already increasing demand for channel space for the growing numbers of made-for-cable services. Although the industry is investing in plant upgrades and installing fiber optic technology for the future, the public will not be well-served by ATV systems that consume excessive amounts of spectrum.

INDUSTRY-WIDE VIEWS

(Footnote continued)

transmission format must, therefore, be capable of incorporating effective encryption techniques.

At this juncture in advanced television development, there is widespread agreement among industry participants on certain issues but widely divergent views on others. The shared views -- regarding testing, consensus-building and inter-operability between media -- should set the stage for meaningful analysis of the complex issues as the systems become operational. The current consensus should also facilitate the successful transition to an HDTV environment for all video delivery media. In the following discussion, we will highlight these areas of broad agreement.

1. Testing

First of all, it is significant that there is virtually universal agreement in the communications industry that extensive testing and evaluation of HDTV systems is an integral, indeed crucial, component of the HDTV standards-setting process. And while preliminary, hypothetical studies are useful to framing the issues and policy options, they are no substitute for hard data from both laboratory and field tests. Moreover, the overall economic and policy questions surrounding the introduction of advanced television rest, in part, on the resolution of many of the technical issues and the outcome of comparative system analyses. Therefore, the video delivery media strongly believe that the performance claims, transmission capabilities and spectrum demands of the various candidate systems must be verified through actual hardware testing before any decisions on standards can be made.

The broadcast and cable industries' drive to conduct the necessary tests is only limited by the availability of hardware. In preparing for the advent of fully operating prototype systems, the Advanced Technology Test Center (ATTC) is currently refining test plans and methodologies and installing test facilities. Cable Laboratories, Inc., in cooperation with ATTC, is also developing comprehensive procedures for testing the suitability of candidate ATV systems for cable carriage.[3/] In addition, the Advanced Television Systems Committee (ATSC), which is an inter-industry organization, is committed to evaluating these tests and making recommendations on standards.

Given the readiness of the broadcast and cable industries to test ATV systems, there is no need to decide these issues on the basis of thin information. Indeed, the quality/bandwidth and quality/cost tradeoffs that must be made depend on the existence of sufficient empirical data and test results on spectrum requirements. ATTC is projecting early 1990 to begin testing and the FCC Advisory Committee hopes to be able to reach standards recommendations by the end of 1991. This timetable is, of course, necessarily linked to the availability of system hardware for formalized testing.

The second major area of agreement among industry participants really goes hand-in-hand with the first area -- that is,

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3/ Cable Labs, which was created in May of 1988 by several major cable system operators, is a research and development organization that is identifying and studying the application of new technologies to cable television. Advanced television is one of its top priorities.

the need for subjective testing of viewer perception of the increased video resolution and other enhancements offered by ATV. Such testing is important because despite the widely-recognized technical achievements in improving television picture and sound quality, in the end the consumer will be the judge. In an effort to define advanced television standards that are responsive to consumer desires, the FCC Advisory Committee created working groups on subjective assessment and audience research. In addition, ATTC and Cable Labs are jointly developing a psychophysical test plan. In light of these activities, the government should refrain from taking action on ATV standards until information on consumer reaction to the technology is available for consideration.

2. Consensus-Building

In addition to testing, industry participants generally endorse consensus-building through the inter-industry advisory groups and technical organizations as the means to achieve ATV standards and guidelines. Thus, despite the inherent biases and differing positions brought to the table, the industries intend to work together to implement a sensible and orderly transition to ATV. There is every indication that they will continue to coordinate their independent and joint efforts through the FCC Advisory Committee (and its working parties), and through other such organizations. The wealth of resources and expertise that is being marshalled by the communications industry in this process is available to the government, and we hope will be used

by Congress, as it oversees the development of ATV in this country.

3. Inter-Operability Between Media

As previously noted, the shift from the current NTSC system to an ATV system may see the adoption of media-specific transmission formats. There is little doubt, however, that the development of multiple, incompatible television receiver standards would slow down the transition to ATV and result in public confusion and market instability. Perceived consumer unhappiness over the "Beta vs. VHS" wars and the inability to advance AM stereo are indicators that consumer demand for HDTV will be affected by the "consumer friendliness" of HDTV television sets.

Thus, "inter-operability", (or the television set's ability to receive and display picture information regardless of the transmission source), has become the watch word for the broadcast, cable, satellite, consumer electronics and other interested industries in the development of ATV standards. There is disagreement as to whether inter-operability should be accomplished through marketplace forces, through voluntary industry guidelines or through regulatory mandates, but it is consistently held that some form of cost-effective interconnection is necessary.

NCTA has taken the position that the common interests of the alternative video delivery media is a tremendous incentive to spur the development of compatibility standards. Moreover, since

nonbroadcast media (such as cable) provide relay facilities in the delivery of broadcast signals, achieving compatibility between these media will be particularly important. In the event that multiple transmission standards evolve, there are several avenues available to the communications industry to achieve compatibility. The options currently under consideration are an "open architecture" receiver or an external "multi-port" interface connector device.

a. Open Architecture Receiver

The open architecture receiver, which encompasses several different approaches, has been the subject of significant debate among the participants in the ATV process. The term typically is used to refer to a "smart" receiver, that is, a television set that is capable of identifying and receiving different transmission formats. This is accomplished by a computer-like bus and monitor (with built-in circuitry) that utilizes plug-in cards containing software programming to perform signal reception and processing. The consumer electronics industry and others have strongly objected to this "all-inclusive" approach to ATV standards-setting on the grounds that open architecture sets will be too costly and too complex. They also have asserted that open architecture will reduce production economies, delay ATV introduction and raise consumer safety concerns.

NCTA is concerned that there may be significant drawbacks to an all-inclusive open architecture approach to ATV. In particular, the cost of an ATV set with integrated signal

processing circuitry capable of translating different standards would apparently be quite high. This high cost, added to an already expensive ATV receiver, could have a negative impact on rapid consumer acceptance of ATV technology. Moreover, consumers may not want the task of having to sort out various receiver cards or to physically install them.

These perceived shortcomings to a fully open architecture receiver may tilt the scales in favor of other methods of accommodating various transmission formats. As discussed below, conversion capability could be achieved by incorporating an external device on the back of the receiver, such as a "multi-port" connector or a baseband circuit board.

b. Multi-port Interface Connector

A "multi-port" connector is an interface device that enables different peripheral devices to access a common display unit. A multi-port connector, similar to the Electronic Industries Association's IS-15 standard, could be readily adapted to convert multiple ATV transmission formats to a display picture. In fact, the FCC Advisory Committee's Planning Subcommittee Working Party on Alternative Media Technology and Broadcast Interface has been developing the specifications for an ATV multi-port connection standard. The cable industry has been very involved in that effort.

In order for the multi-port alternative to be effective, it is imperative that a baseband component video (BCV) signal be specified for all media. This minimum standard should define the

number of scan lines, the field rate, and the aspect ratio for all ATV transmissions. As the lowest common denominator signal, the BCV signal would provide an economical and practical means to interconnect ATV signals from various feeder and distribution systems. Without this minimum amount of standardization, the television receiver would have to incorporate built-in circuitry to convert between different systems. Moreover, such minimal standards will have the added benefit of promoting economies of scale in ATV receiver manufacturing and production.

The development of various approaches to achieving interoperability in advanced television receivers could provide a means for the American electronics industry to get involved in the production and manufacturing side of the ATV industry.

CONCLUSION

Beyond the foregoing areas of agreement, the industries differ with respect to issues ranging from whether to compel an NTSC-compatible HDTV system to whether to endorse a particular HDTV production standard. And in some instances, they completely diverge philosophically on the overall future direction of advanced television. Given the lack of technical information that is presently available on the proponent systems, the industries cannot yet effectively debate these issues. More importantly, because of this fact, we believe it would be premature for the government to decide these issues at this time.

While the search is underway for the optimum HDTV system, the government may decide to take steps to encourage substantial participation by U.S. producers and manufacturers. For our part, the cable industry is forging ahead in this field and others through the efforts of Cable Labs. It is our hope that the development of HDTV standards will proceed hand-in-hand with the American electronics manufacturers' ability to produce the best and most cost-effective HDTV hardware for the American consumer.

NCTA stands ready to work with the Subcommittee as it continues to monitor the development of HDTV. We respectfully request that these comments be made a part of the record of the Subcommittee's hearings on this important new technology.